JEFFERSON PARISH

Watershed Management Plan

Submitted for:

Louisiana Silver Jackets

August 18, 2021

Prepared by:

MSMM Engineering, LLC

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Foreword

This study was prepared under the authority provided by Section 206 of the 1960 Flood Control Act (PL 86-645), as amended. Under this authority the Corps of Engineers can provide the full range of technical services and planning guidance that is needed to support effective flood plain management. General technical assistance efforts under this program includes determining: site-specific data on obstructions to flood flows, flood formation, and timing; flood depths, stages or floodwater velocities; the extent, duration, and frequency of flooding; information on natural and cultural flood plain resources; and flood loss potentials before and after the use of flood plain management measures. Types of studies which have been conducted under the FPMS program include: flood plain delineation/hazard, dam failure analyses, hurricane evacuation, flood warning, floodway, flood damage reduction, stormwater management, flood proofing, and inventories of flood prone structures.

This product is not a U.S. Army Corps of Engineers decision document; rather, it is a Louisiana Silver Jackets product. MSMM Engineering, LLC was contracted by the U.S. Army Corps of Engineers to assist Jefferson Parish in developing this watershed management master plan to conform with the standards established by the National Flood Insurance Program, CRS Credit for Stormwater Management.. The stormwater hydrology and hydraulic SWMM models used in hydrogaph modeling for planning purposes were developed by Jefferson Parish and were not reviewed or approved by the Corps. The SWMM models which were used by the Parish to provide insight into trends in watershed impacts due to rising sea levels, changing storm frequency-intensity duration standards, and changing land use are the sole responsibility of the Parish. The output from these models is intended only for the high-level management planning provided in this report and should not be used by others for other purposes.

SILVER JACKETS POINT OF CONTACT

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1.0 Executive Summary

The purpose of this Watershed Management Plan (WMP) is to provide an assessment of how flood stages will be affected by projected changes in future rain and sea-level conditions as well as to recommend strategies for mitigating increased flood loss damages caused by the projected environmental changes and by redevelopment and new development in the Jefferson Parish area watersheds. The plan has been organized to satisfy the requirements for the Community Rating System Activity 450: Storm Water Management. The National Flood Insurance Program, Community Rating System FEMA publication, "CRS Credit for Stormwater Management, 2020" was used as the guide for preparation of this WMP. Consultation with FEMA coordinators was performed in scoping the specific hydrologic and hydraulic analyses most relevant to the Jefferson Parish watershed.

The objective of FEMA watershed master planning is to provide a community with a framework to make decisions that will result in decreased losses from flooding. Jefferson Parish has previously developed ordinances and enacted policies that advance the primary objectives of watershed development and redevelopment to decrease losses from floods. Additionally, the Parish works with the incorporated Cities of Gretna, Harahan, Kenner and Westwego; and the Towns of Grand Isle and Jean Lafitte to designate areas that are prone to flooding through periodic flood modeling and related mapping updates. The Parish maintains all of the canals and pump stations including service of the incorporated areas. The Parish and incorporated areas also work together to provide flood related information to citizens, staff, and elected officials and to improve their understanding and preparedness.

Based on FEMA recommended criteria, the Watershed Management Plan presents an analysis of the existing and future conditions on over 50-percent of the Parish inside the levees for 10-year, 25-year, and 100-year storm events using a hydrograph approach based on EPA SWMM model analysis. SWMM models of the Jefferson Eastbank Polder and the Catouatche Polder were analyzed individually. The combined area of the two polders exceeded the "inside the levee" area criteria of 50-percent. Comparative future conditions were assessed using Technical Paper 40 versus NOAA Atlas 14 rainfall intensity predictions and using current sea level versus NOAA's 2100 intermediate Sea Level Rise Projection which anticipates a 5.8-feet rise in sea level and NOAA 2017 Intermediate-High Sea Level Rise which anticipates a 8.07-feet rise in sea level. Future land use was based on the newly updated Jefferson Parish Comprehensive Plan, Envision Jefferson 2040 land use information. Parish EPA SWMM numerical hydrologic-hydraulic models were used in assessing impacts.

The model analysis indicated that the existing pump system has sufficient capacity to maintain near-present water surfaces in spite of rising sea levels, but the percent utilization and power usage are increased so that maintenance wear and tear, and power provisions should be considered. Considering storm intensity revisions as standard rain intensities are adjusted from historic Technical Paper 40 intensities to the more current NOAA Atlas 14, the values Jefferson Parish uses for 10- and 25-year storms already exceed NOAA Atlas 14 storm intensities. However, the 100-year NOAA storm is 1.4-inches greater than the Technical Paper 40 value used such that associated water surface impacts should be considered in order to anticipate future revision of the flood plain mapping. The storm water surface impacts due to development in the Catouatche Polder were found to be substantial if the area is built out to the future land use plan without mitigation or canal and pump capacity upgrades.

Based on the findings of the SWMM model analyses, recommendations for future development and redevelopment that employ sustainable principles of green infrastructure are addressed to ensure that peak stages for the 10-year, 25-year, and 100-year storm events are not increased. Controlling the volume of runoff as a part of design storm impact mitigation is recommended. Green infrastructure, or low-impact development principles, are considered such as preserving and recreating natural landscape features, separating roof drains and minimizing effective impervious areas to create functional and appealing site drainage are included in the recommendations. These green infrastructure principles are recommended for the future redevelopment of the Eastbank Polder and especially for the future development of the Catouatche Polder. Practices that have been used to adhere to these principles are described, such as use of permeable pavements, narrow street sections in new developments, cluster development, bio-retention facilities, rain gardens, vegetated rooftops, and rain barrels. Recommendations include provision to give the Parish the legal authority to inspect private detention or infiltration facilities and to require the owners to perform appropriate maintenance when necessary, or to require that those facilities be dedicated to the community. It is recommended to increase lifecycle performance and upgrade the capacity of pumping systems and generator systems with consideration of additional wear on the pumping system associated with longer run times due to increased sea-level conditions for both the Eastbank Polder and the Catouatche Polder. Use of Eastbank Polder pump-to-the-river strategies that increase the overall system pumping capacity and reduce the storm runoff burden on the south-to-north canal system is recommended. Having a dedicated funding source for the implementation of the watershed master plan is recommended as prescribed in CRS credit criteria. Continued management of stormwater systems in cooperation with adjacent incorporated communities is recommended. Considering the special below sea-level conditions in Jefferson Parish, improvements in polder isolation systems to reduce area impacts due to flooding, and improved resilience of the Hurricane Storm Damage Risk Reduction System (HSDDRS) to performance rating greater than the 100-year storm are recommended as overarching watershed management strategies.

Many of the recommendations are already in the process of implementation and other recommendations are complementary to existing drainage programs. Environmental and social benefits of the WMP include reduction of losses from flooding, and reduction of transportation facility flood depths and durations as well as enhance environmental and community sustainability through more extreme storm conditions. In addition to the community benefits of loss of damage, the implementation of these green infrastructure low-impact development features will provide substantial environmental and community benefits in the present and for the future.

2.0 Introduction

Jefferson Parish is a long narrow parish (county) located in southeastern Louisiana, adjacent to the City of New Orleans. It is bordered by Lake Pontchartrain to the north, Orleans and Plaquemines Parishes to the east, the Gulf of Mexico to the south, and Lafourche and St. Charles Parishes to the west. The cities of Gretna, Harahan, Kenner, and Westwego; and the towns of Grand Isle and Jean Lafitte are located within Jefferson Parish. The total land area contained within the Jefferson Parish limits is 296 square miles (U.S. Census Bureau, 2019). The northern 14 miles of Jefferson Parish is split by the Mississippi River into an East and West Bank and this portion of the Parish is considered urbanized, and part of the New Orleans Metropolitan Area.

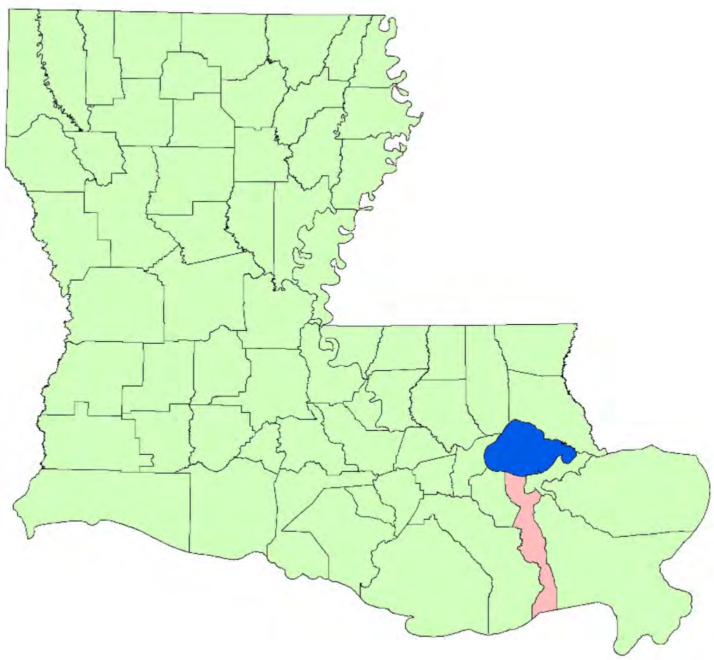

Figure 1: Jefferson Parish Location

Most of the population of Jefferson Parish (nearly ½ million) is in this urbanized New Orleans Metropolitan Area, which has relatively flat topography with ground elevations varying from approximately 10-ft above sea-level at the higher natural ground levels to about five (5) feet below sea-level at street and subdivision grades in the lower areas. The area is protected from imposed flooding by the Hurricane Storm Damage Risk Reduction System (HSDRRS) which encompasses the Greater New Orleans metropolitan area (See Figure 2). The HSDRRS, which was completed by the United States Army Corps of Engineers (USACE), consists of a complex perimeter that includes levees (segments of Lake Pontchartrain & Vicinity levees, and Mississippi River levees), floodwalls, drainage structures, locks, sector gates, and pumping stations all designed for elevation and stability to withstand a 1% probabilistic flooding event originating from river flow or hurricane surge on Lake Ponchartrain and the surrounding coastal water connections. HSDRRS also includes a complex network of interior drainage features consisting of interior pump stations, box culverts, open channels, subsurface drainage systems, and interior floodwall/levee alignments.

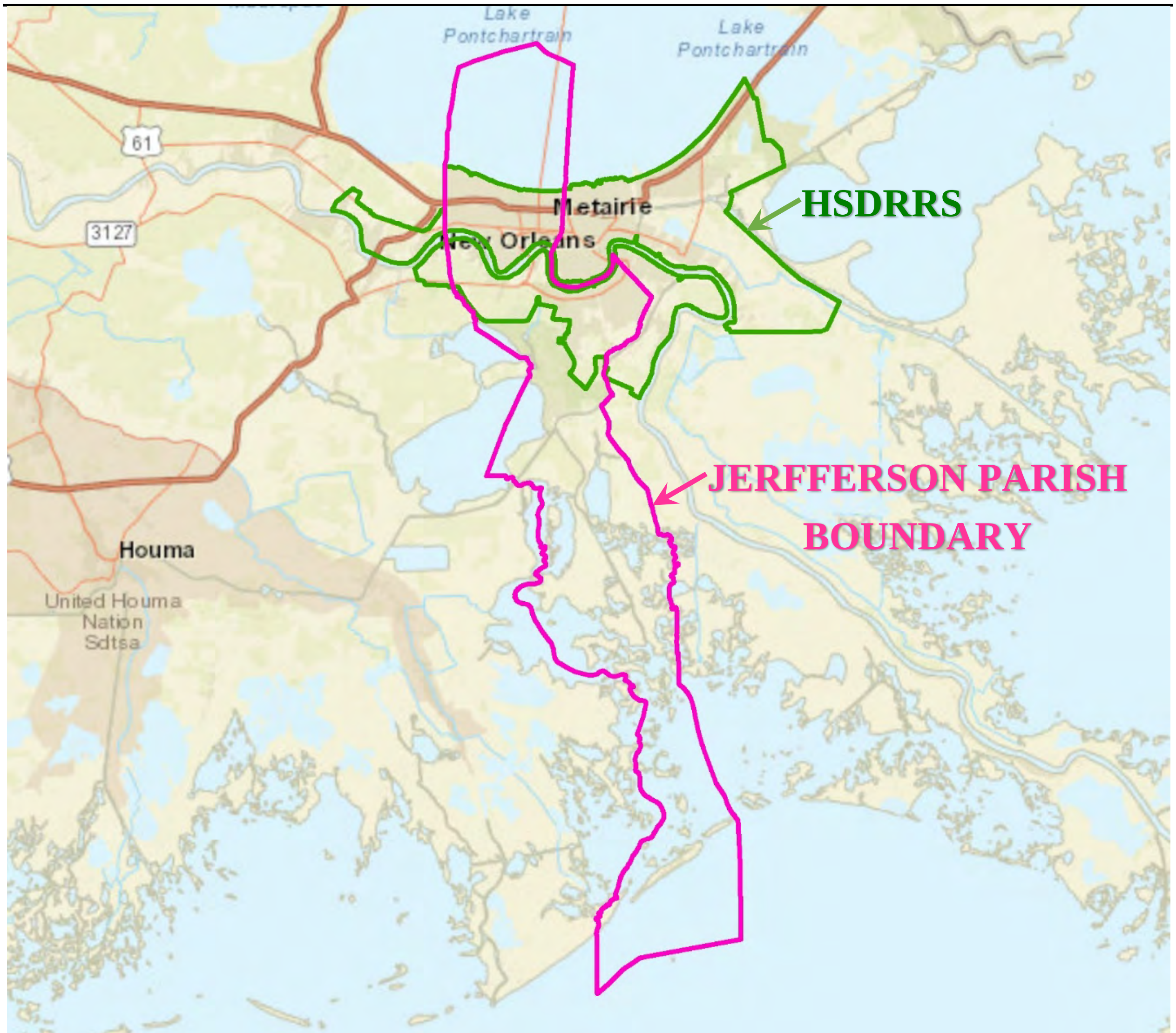

Figure 2: Jefferson Parish Boundary and the HSDRRS System

All storm water runoff within the levee and floodwall system is conveyed by gravity through a system of subsurface drainage lines and canals into the suction bays of various pump stations then pumped into surrounding bodies of water outside of the flood protection system. The Jefferson Parish Department of Drainage is responsible for the administration, direction, coordination and implementation of major drainage and flood control programs and direct operation, construction and maintenance of:

- 340 miles of drainage canals, drainage ditches, crossdrains, culverts, and levee systems
- 1465 miles of street subsurface drainage systems
- Operation and maintenance of 71 drainage pump stations

The Drainage Department also schedules and monitors pump station screen cleaning operations, canals and waterways trash pickup and grass cutting. The Department plans and coordinates construction of capital improvements and special projects. It maintains and manages the Parish wide Drainage and Flood Control System, Supervisory Control and Data Acquisition (SCADA) flood gauges and associated structures.

For purposes of watershed management, storm routing, and storm modeling, the Jefferson Parish watershed within the HSDRRS is divided into sub-basin areas. The FEMA Flood Insurance Study refers to these sub-basin areas as “polders” which is a dutch word derived from reference to a marshy tract of land which has been reclaimed from the sea or other body of water and protected by dikes. (See Figure 3)

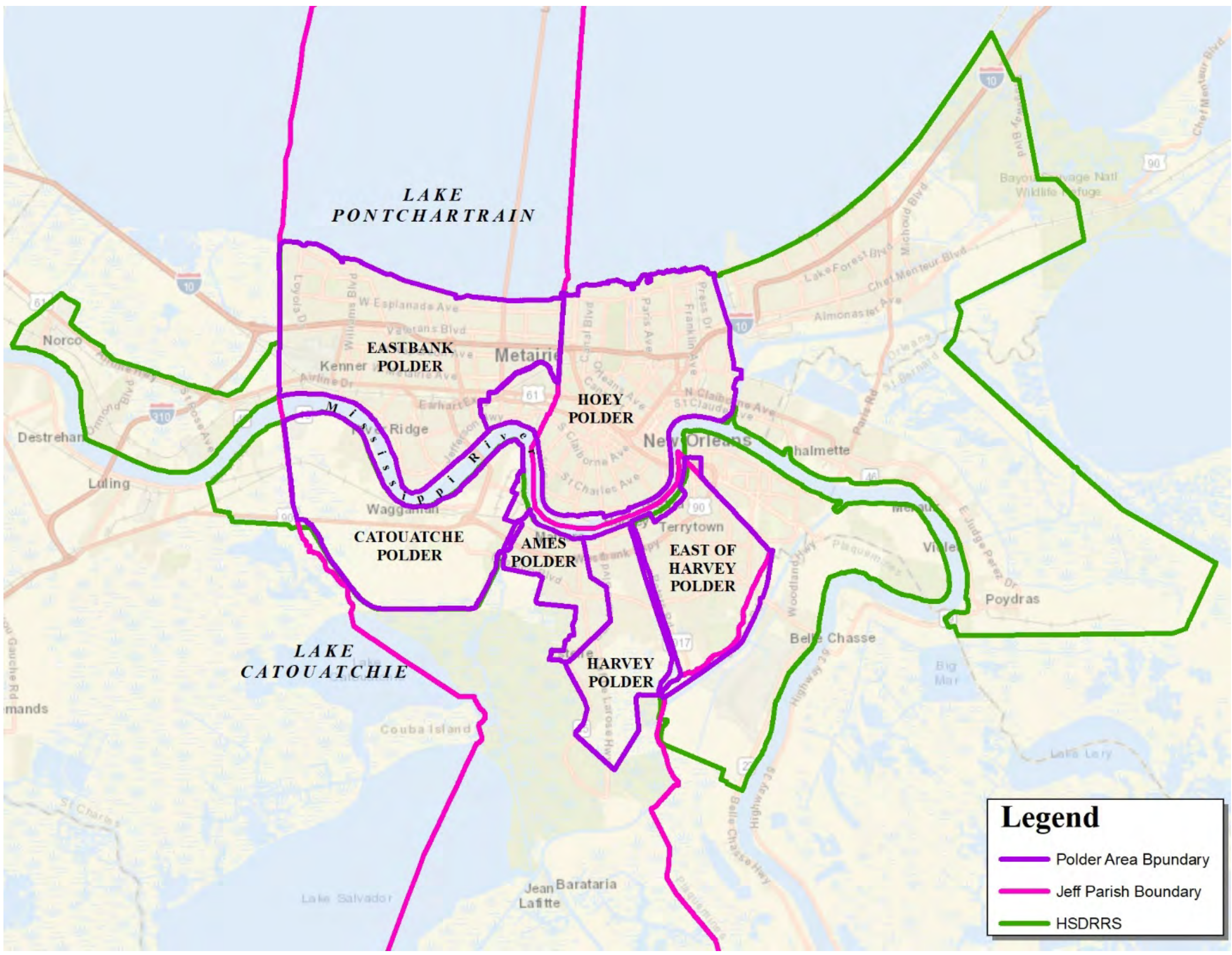

Figure 3: HSDRRS, Partial Parish Limits, and Polder Areas Within Parish

The Jefferson Parish polder areas within the HSDRRS include the following:

- Ames Westwego Polder
- Catouatche Polder
- East of Harvey Polder
- Harvey Estelle Cousins Polder
- Hoey's Polder
- Jefferson East Bank Polder

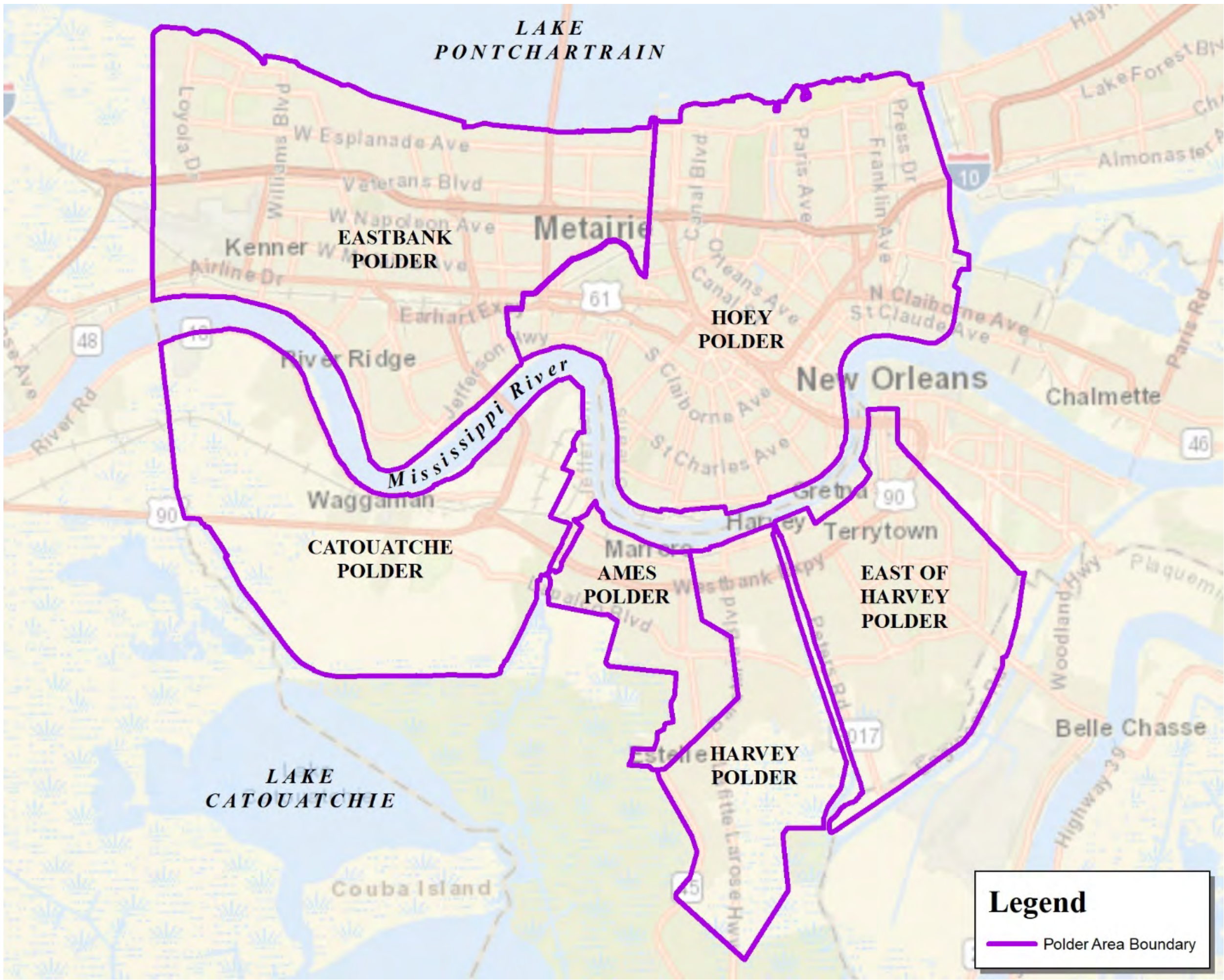

Figure 4: Parish Polder Areas

In consultation with FEMA, it was determined that in order to develop strategies for watershed management, Jefferson Parish should develop hydrograph-type models for at least 50-percent of the unincorporated areas within the HSDRRS Levee system. Depictions of the Jefferson Parish area Eastbank and Westbank area within the levee system are shown in Figure 5.

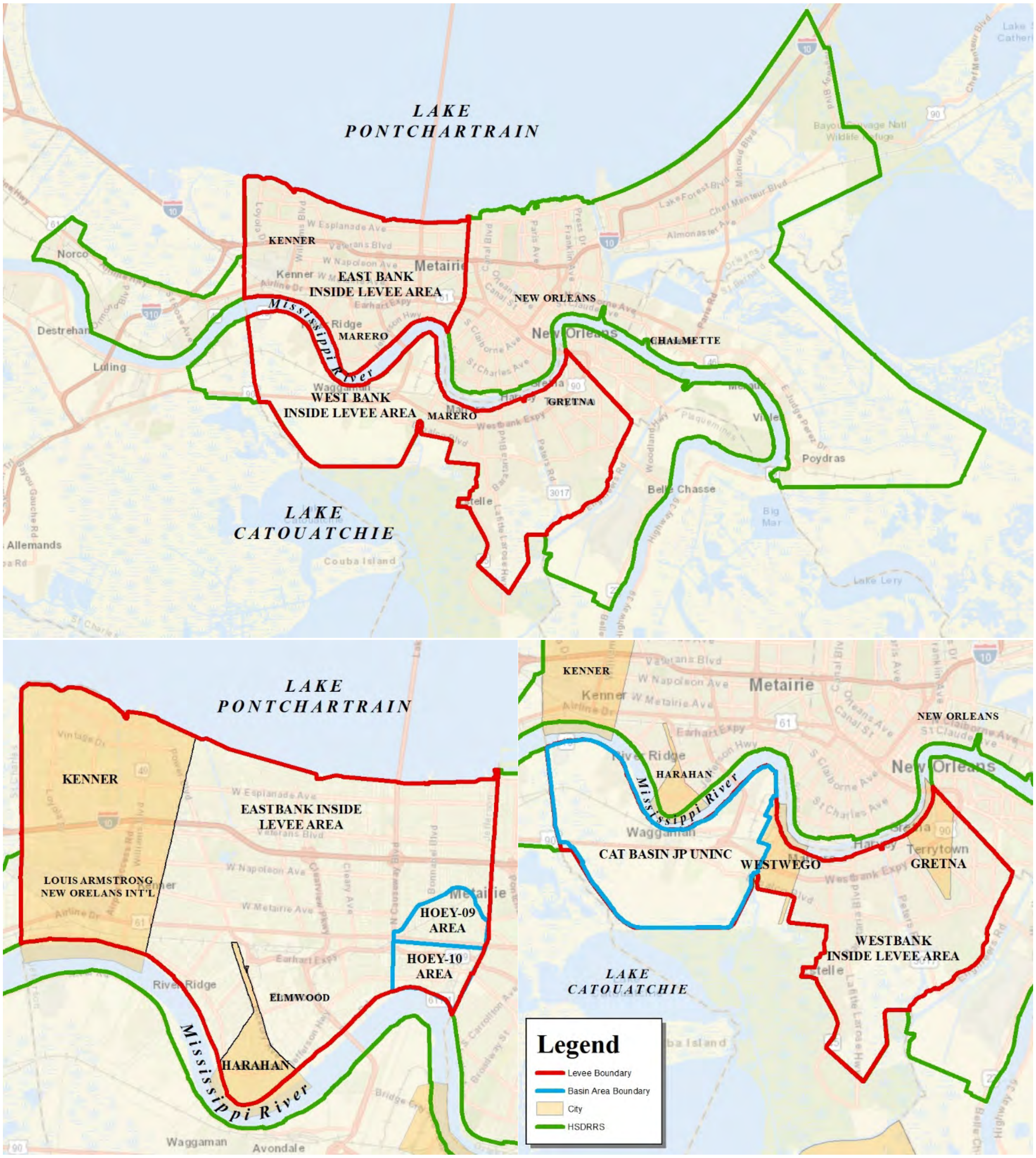

Figure 5: Jefferson Parish Eastbank & Westbank Area within Levee System

Area calculations used to determine the Unincorporated Eastbank Polder area and the Westbank Catouatche Polder area constitute approximately 60-percent of the Unincorporated area within the levee system area which exceeds the "50-percent criteria" is tabulated in Figure 6.

Jefferson Parish Area Inside Levees					
	Eastbank	30,662	acres	47.9094	sq miles
	Westbank	47,496	acres	74.2125	sq miles
		78,158	acres	122.1219	sq miles
Incorporated Areas Inside Levees					
	Harahan Inside Levees	1,117	acres	1.7445	sq miles
	Kenner Inside Levees	9,324	acres	14.5683	sq miles
		10,440	acres	16.3128	sq miles
	Gretna Inside Levees	2,555	acres	3.9914	sq miles
	Westwego Inside Levees	1,822	acres	2.8475	sq miles
		4,377	acres	6.8389	sq miles
Unincorporated JP Inside Levee					
	Eastbank Unincorporated	20,222	acres	31.5966	sq miles
	Westbank Unincorporated	43,119	acres	67.3736	sq miles
	Total Eastbank & Westbank Uninc	63,341	acres	98.9702	sq miles
	50% of Total	31,670	acres	49.4851	sq miles
Unincorporated Hoey Basin in Jefferson Parish		1989	acres		
	JEB Model JP Uninc	18,233	acres	28.4888	sq miles
	Cat Basin Model JP Uninc	19,848	acres	31.0125	sq miles
	Total Unincorporated Model Area	38,081	acres	59.5013	sq miles
	% of Total Modeled	60%			

Figure 6: Jefferson Parish Westbank Area within Levee System Calculations

The Jefferson Parish Eastbank Polder storage areas and the Catouatche Polder storage areas as depicted in the current Flood Insurance Study are shown in Figure 7 and Figure 8, respectively. The study areas are depicted collectively in Figure 9 with the subcatchments illustrated.

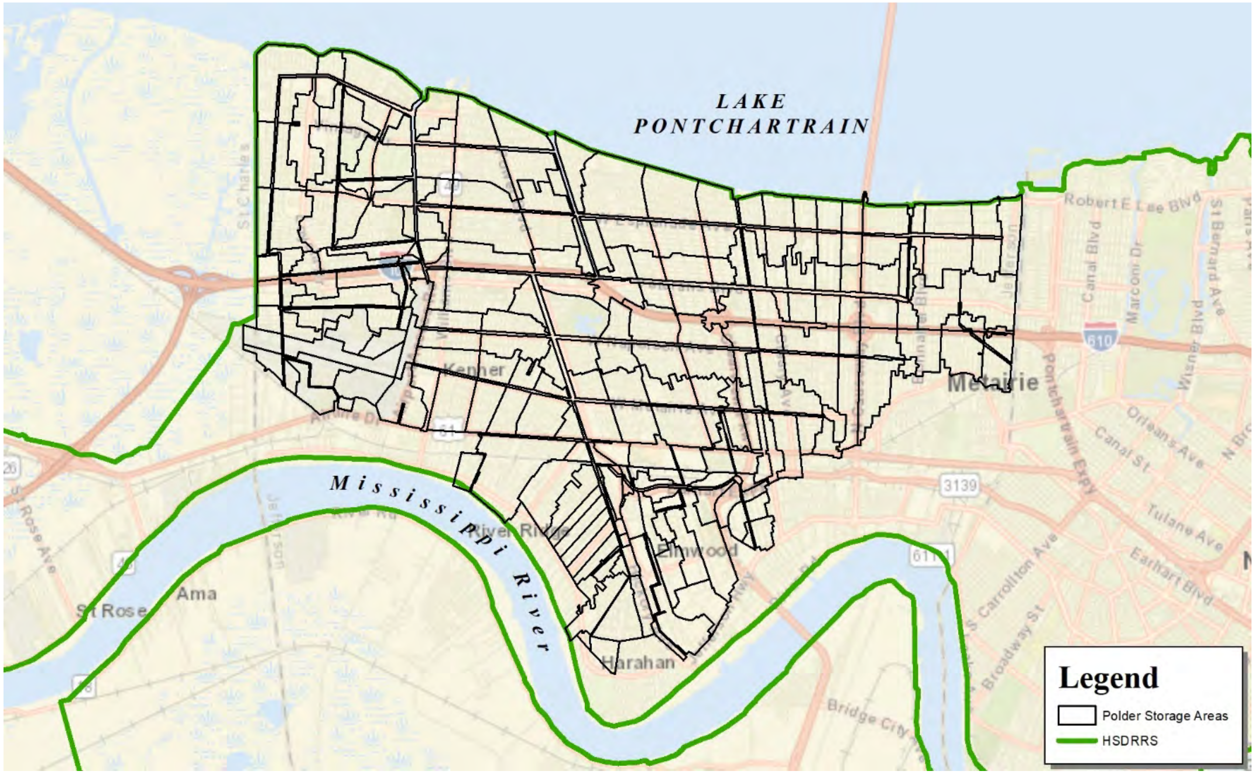

Figure 7: Jefferson Parish Eastbank Polder Storage Areas As-Per FIS

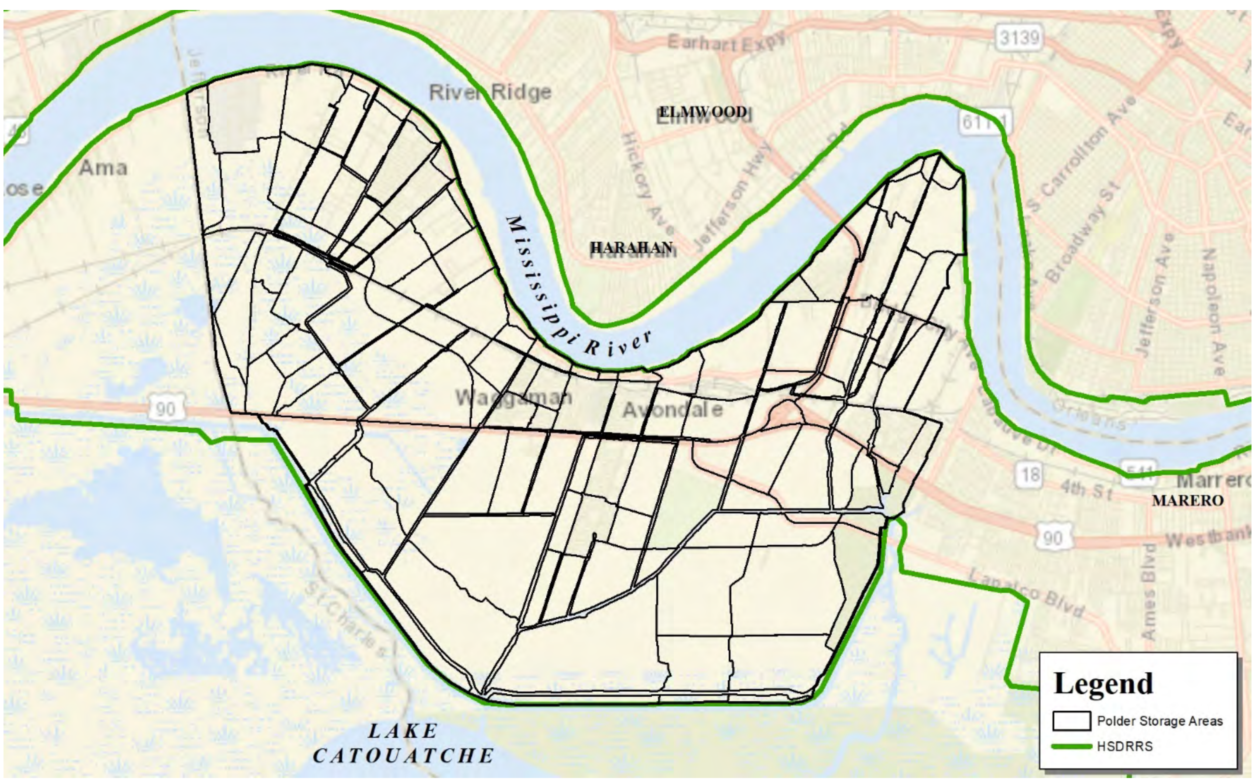

Figure 8: Catouatche Polder Storage Areas As-Per FIS

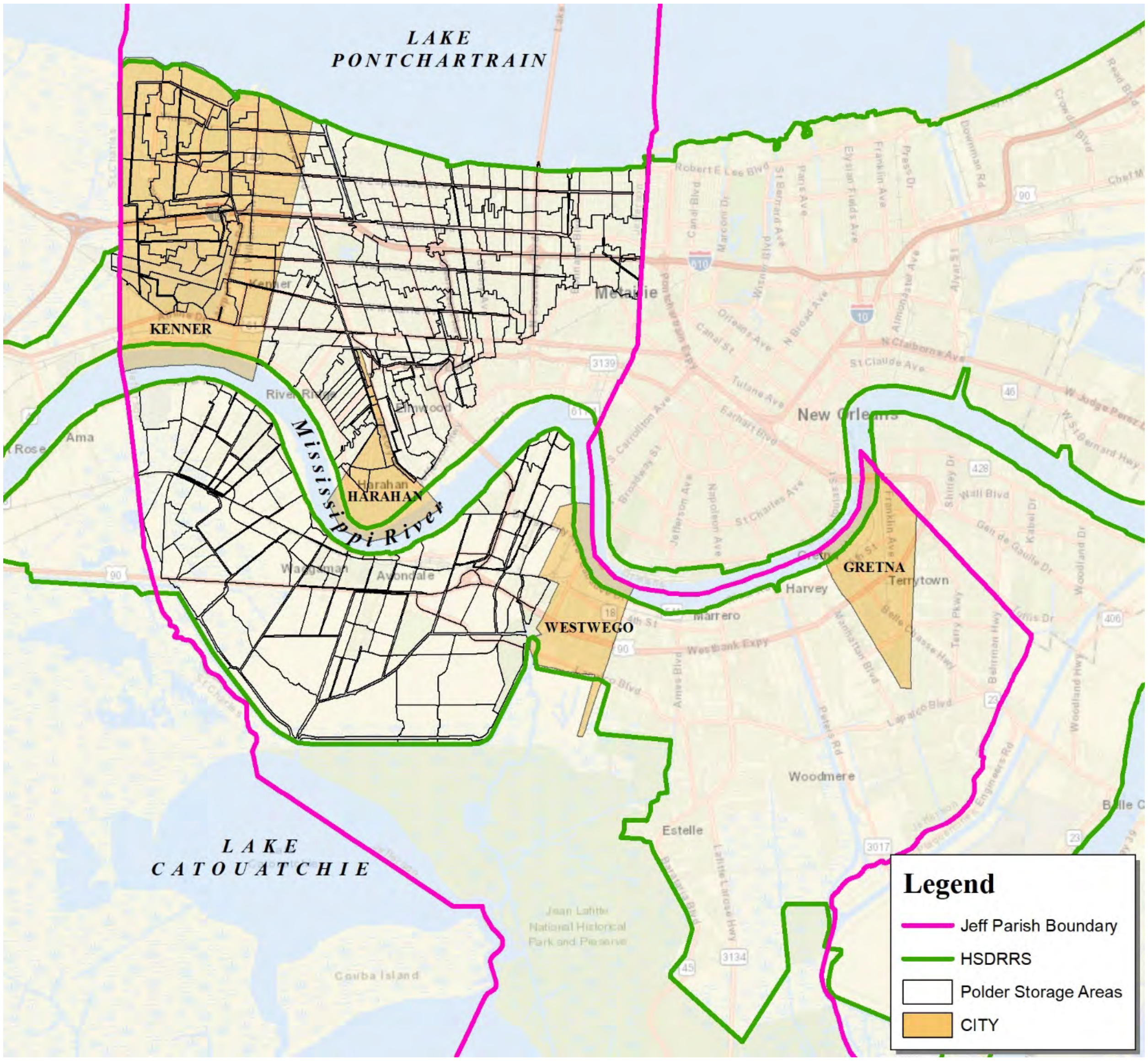

Figure 9: Jefferson Parish Eastbank and Catouatche Polder Subcatchments

3.0 Existing Conditions

The Mississippi River divides the parish into two distinctly different communities. Development on the east bank of the Mississippi River occurred in a rapid timeframe and consists mainly of residential and commercial improvements. Although some industrial development is located on the east bank of the river, most of the heavy industrial concentration is found on the west bank. In recent years, the west bank area has also experienced rapid residential development.

3.1 Physical Storm Water Controls (HSDRRS – Pumps – Canals)

The federally-constructed Mississippi River and Tributaries Levee protects Jefferson Parish from flooding due to high stages in the Mississippi River. On the east bank of the parish, the Lake Pontchartrain and Hurricane Protection Levee affords protection from hurricane surges from Lake Pontchartrain. The west bank area is partially protected from hurricane surge from the Gulf of Mexico by parish-built levees.

After Hurricane Katrina hit, the USACE repaired and restored the HSDRRS. The protection system consists of levees, floodwalls, floodgates, outfall canals, locks, surge barriers, and pump stations in the five-parish Greater New Orleans area. A perimeter levee system protects the area from the coastal surge and the Mississippi River flooding. Pump stations are located along the perimeter levee to discharge local runoff into the exterior lakes or the Mississippi River. Local pump stations perform the same function along interior levees and discharge to marshy areas designated to collect flood water from developed areas. Two major closure complexes, the West Closure Structure Complex and the Inner Harbor Navigation Canal Complex keep the surge from entering the major canals and navigation channels within the New Orleans area. The HSDRRS is designed to protect the Greater New Orleans area from the 1-percent-annual-chance flood. FEMA specifies that all levees must have a minimum of 3-feet of freeboard against 1-percent-annual-chance flooding to be considered a safe flood protection structure. The HSDRRS meets the FEMA freeboard requirement. The HSDRRS levees are not rated to sustain a 500-year event such that for purposes of Flood Insurating Rating Mapping, the 500-year water surface is uniformly identified as Elevation 12-ft NAVD88 within the Jefferson Parish Polders. This water surface corresponds with extensive depths of flooding throughout most of the area within levees.

3.2 Land Use— Impervious Coverage, Streams, Wetlands, Open Space

The current Jefferson Eastbank Polder hydrologic model utilizes a percent impervious area of 52 percent. The current Catouatche Polder utilizes a percent impervious area of 11 percent. Considering streams and wetlands, the U.S. Fish and Wildlife Service, National Wetlands Inventory shows only sparse wetland locations in the Jefferson Eastbank Polder. However, in the Catouatche Polder, National Wetlands Inventory shows approximately 9,700 acres of freshwater forested/shrub wetlands and 1,800 acres of freshwater emergent wetlands. Aerial imagery of the Eastbank and Catouatchie polders with the major canals and pump station locations delineated is shown in Figure 10.

Jefferson Parish has forty-three parks which provide open spaces with typically low impervious areas and in many cases provide some detention value to the overall drainage network. The park locations are shown in Figure 11 and Figure 12.

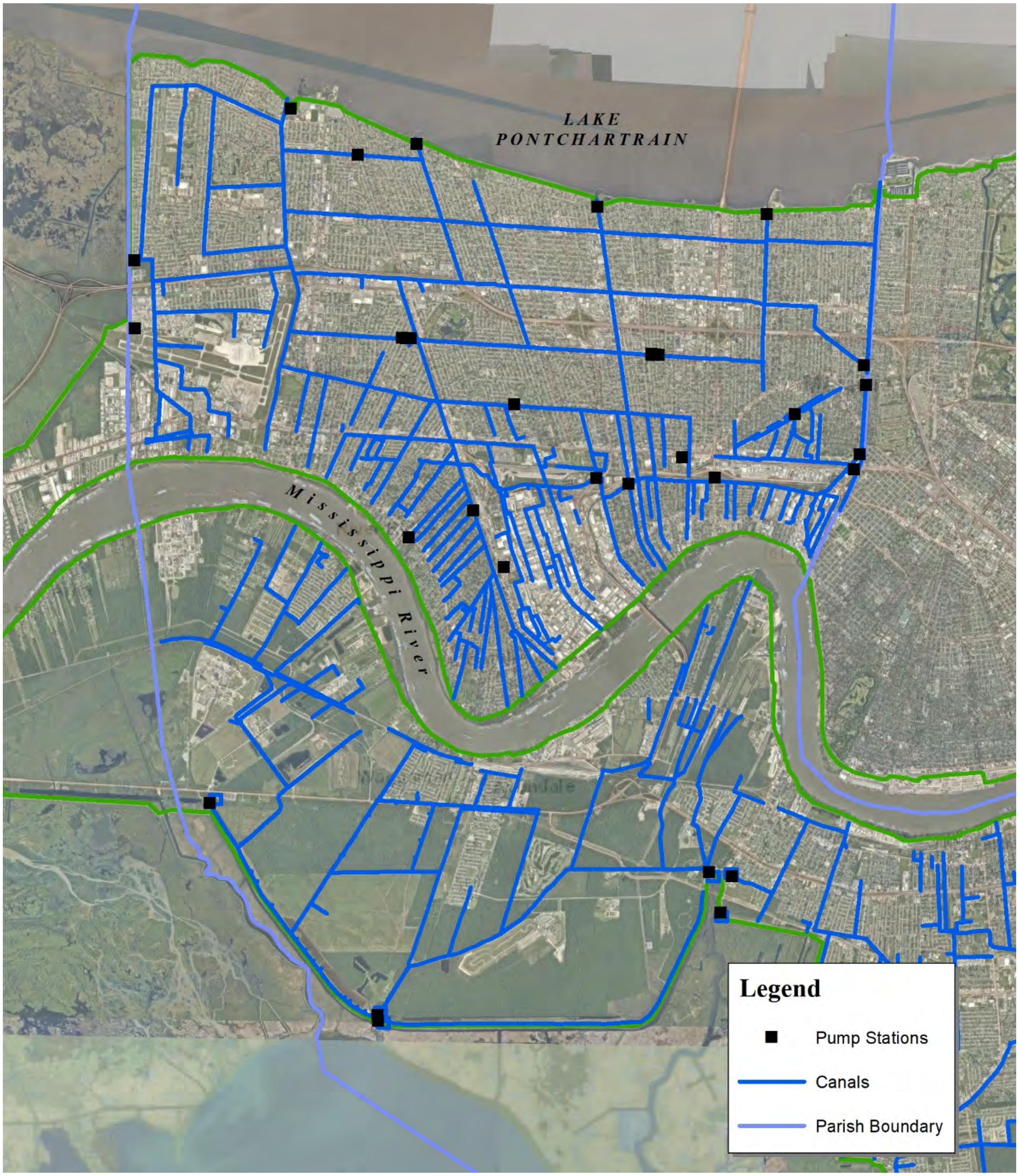

Figure 10: Aerial Imagery of Eastbank and Catouatche Polder

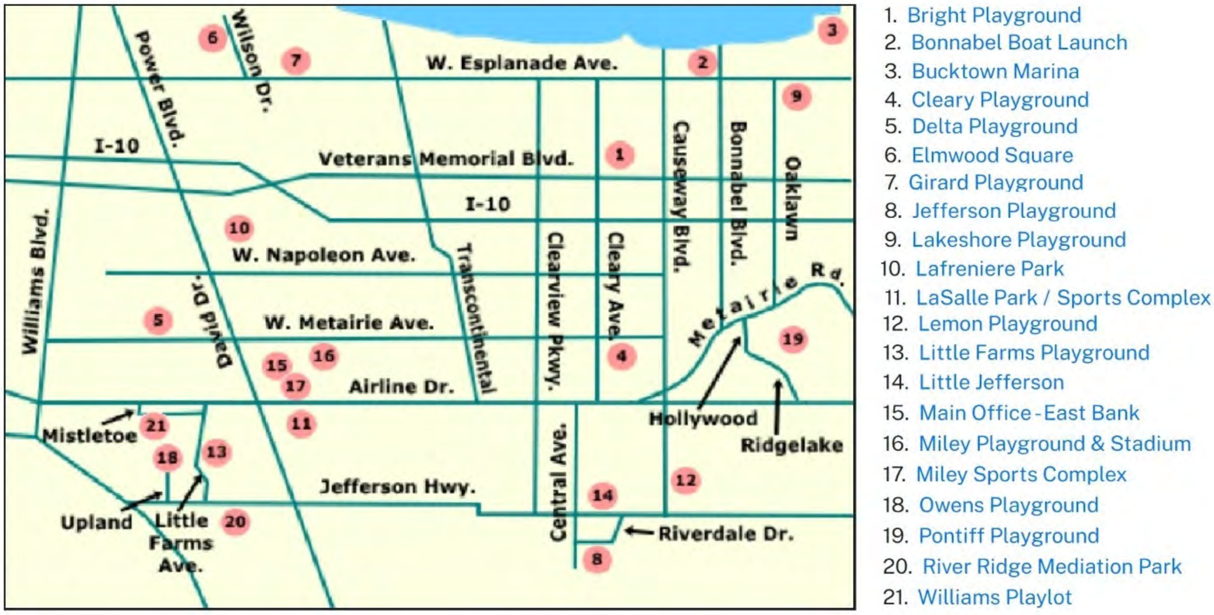

Figure 11: Jefferson Parish Eastbank Recreation Facilities

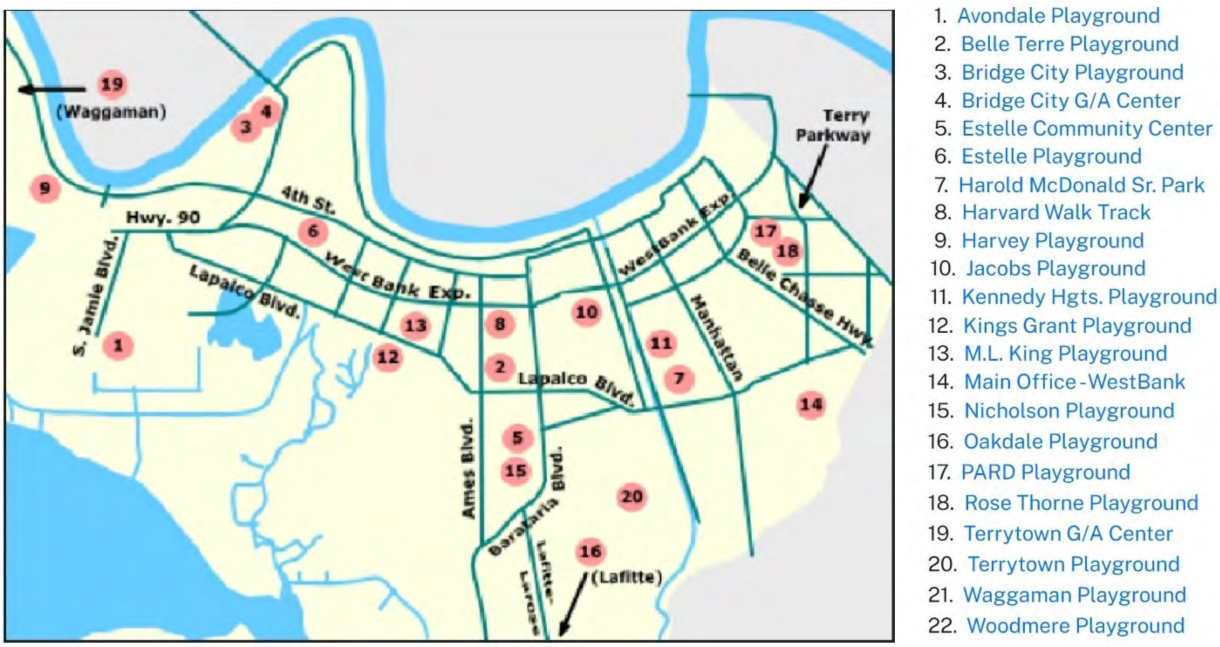

Figure 12: Jefferson Parish Eastbank Recreation Facilities

3.3 Models (10, 25 and 100-year Events Using a Hydrograph Approach

The current Parish EPA SWMM models for the Jefferson Eastbank Polder and the Catouatche Polder were utilized to perform a hydrograph-type assessment of the existing conditions. The models were run for existing conditions to establish baseline water surface and hydrographs for the study areas. Runs were performed for the 10-year, 25-year, and 100-year storm events with the Technical Paper 40 (TP 40) and NOAA Atlas 14 rain parameters denoted in Figure 13.

	Duration	Point precipitation (inches)		
Probability:		10%	4%	1%
Return Period:		**10-YR**	**25-YR**	**100-YR**
Metairie NOAA Atlas 14:	24-hr	8.33	10.50	14.40
Jefferson Parish TP 40 Metairie:	24-hr	9.40	11.12	13.00

Figure 13: Precipitation-Duration-Frequency Values for SWMM Models

Subcatchment impervious factors, conduit size and lengths, and junction inverts and rim elevations were used as presented in the Parish models. Model values for tailwater elevations at the outfalls were used as presented in the Parish model or adjusted to reflect the values used in the RAS models used to develop the FIRM elevations. The FIRM elevations were based on Adcirc modeling of Lake Ponchartrain.

3.4 Identification of Issues

In preparation of precipitation-duration-frequency values, it was noted that the 10-Yr and 25-Yr NOAA Atlas 14 values are lower than the Jefferson Parish Technical Paper 40 values for Metairie. It is unlikely that the Parish will reduce the rain standard to the lower values for these events. However, it was further noted that for the 100-year event, the NOAA Atlas 14 value is 1.4-inch higher than the Jefferson Parish Technical Paper 40 value used in preparing water surfaces for the current FIS. This issue should be investigated further to determine potential ramifications on future flood studies.

The updating of the Parish hydrologic-hydraulic model to reflect the improvements and addition of pumping appurtenances and canal features is an ongoing issue. Because of the inter-relation of the canal-pump system as the outfall for the storm drainage pipe and inlet system, flood stages within each polder are dependent upon the canal system flood stages. Some pumping capacity at existing stations and some existing additional pumping facility pumps were not included in the model run. This understated pump capacity was a uniform condition for the existing and future comparison, so it is not expected to be a significant issue for comparison purposes. However, it does reflect that updating the models to include the additional pump paramaters is an issue that should be addressed.

4.0 Future Conditions

Considerations in assessment of future conditions included land use and development in the watershed, storm pattern analytical adjustments as NOAA Atlas 14 intensity is considered a preferred standard statistically, and changes in sea-level impacting the outlet tailwater at the Parish pump stations.

4.1 Fully Developed Land Use and Sea Level Rise

Characterization of the future conditions was based on information in the Jefferson Parish Future Land Use Plan as documented in Figure 14. The Eastbank Polder was considered to be fully built to the future land use conditions. The Catouatche Polder was considered to be in transition to development, so, the impervious areas were adjusted for future conditions models to reflect a build-out to the future land use depicted in Figure 14. The future Catouatche build-out percent impervious was calculated as 69 percent impervious based on typical Jefferson Parish impervious rates for the future land uses projected. This was a 58 percent increase over the existing 11 percent impervious rate parameter included in the SWMM model.

NOAA reports that global mean sea level has risen about 8–9 inches (21–24 centimeters) since 1880, with about a third of that coming in just the last two and a half decades. The rising water level is mostly due to a combination of meltwater from glaciers and ice sheets and thermal expansion of seawater as it warms. In 2019, global mean sea level was 3.4 inches (87.6 millimeters) above the 1993 average—the highest annual average in the satellite record (1993-present). From 2018 to 2019, global sea level rose 0.24 inches (6.1 millimeters). Rising sea levels are projected using current sea level versus NOAA's 2100 intermediate Sea Level Rise Projection which anticipates a 5.87-ft rise in sea level and Int-High 8.07-ft rise in sea level.

Past and future sea level rise at specific locations on land may be more or less than the global average due to local factors: ground settling, upstream flood control, erosion, regional ocean currents, and whether the land is still rebounding from the compressive weight of Ice Age glaciers. In the United States, the fastest rates of sea level rise are occurring in the Gulf of Mexico from the mouth of the Mississippi westward, followed by the mid-Atlantic.

For this analysis, the USACE Sea Level Change Curve Calculator (2021.12) was utilized to determine the Intermediate projected sea level rise for the years 2075 and 2100 and Int-High sea level rise for the year 2100. The Grand Isle Gauge and the NOAA et al 2017 curve were used to derive a table of values from which the NOAA 2017 Intermediate and Int-High values were used to define the sea level rise for the analysis. The Sea Level Calculator Website is: *https://cwbi-app.sec.usace.army.mil/rccslc/slcc_calc.html*

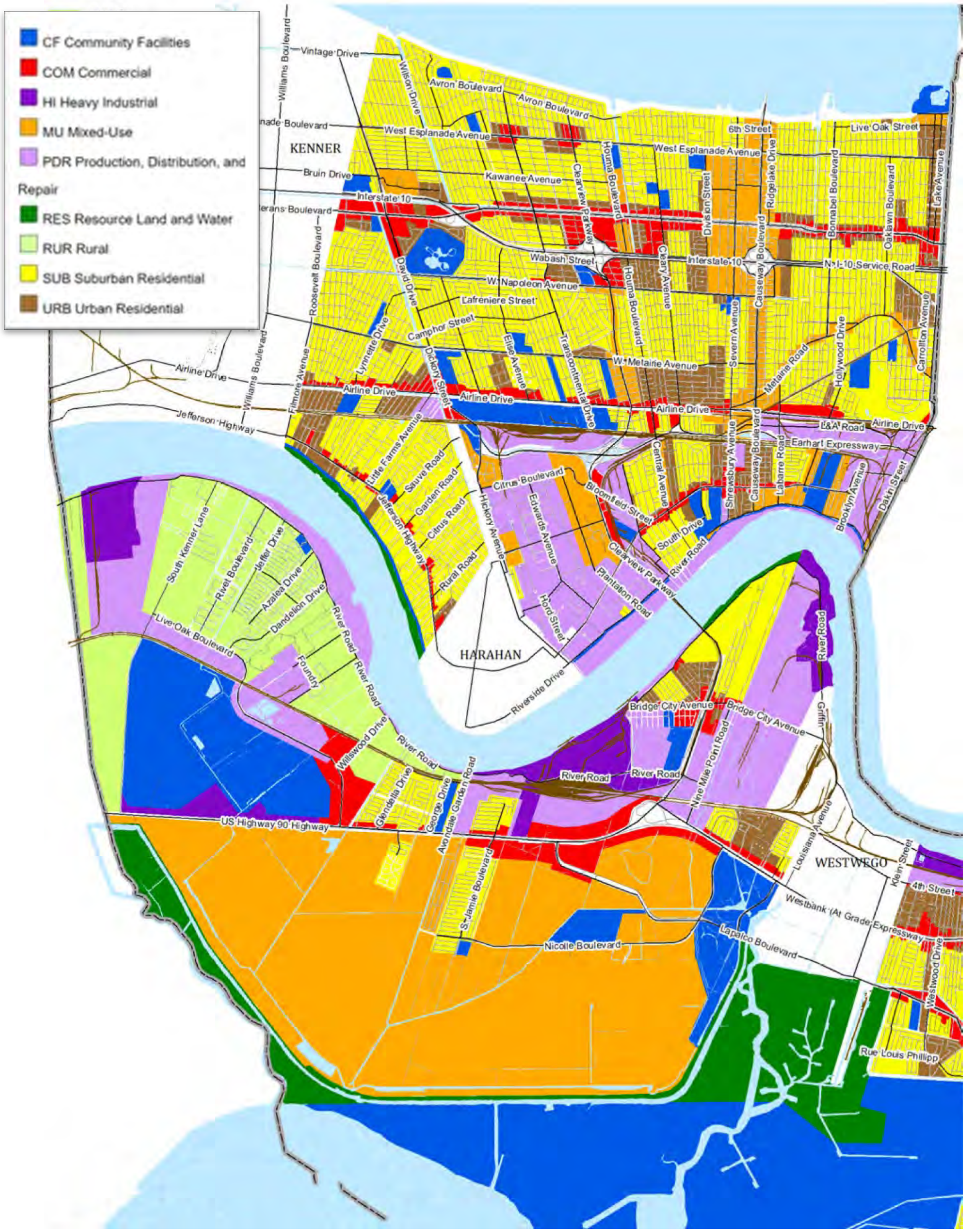

Figure 14: Jefferson Parish Future Land Use Plan

The sea level change at Dauphin Island, which is close in latitude to the study area was considered as the gauge location for analysis, however, the Grand Isle Gauge values were higher, so the Grand Isle gauge was considered to provide a more conservative estimate. Locations of the gauges are shown in Figure 16. The table used to derive the sea level adjustments for the NOAA 2017 Intermediate years 2075 and 2100 and Int-High year 2100 is depicted in Figure 17.

Figure 16: NOAA Gage Locations at Dauphin Island and Grand Isle

Jefferson Parish WMP Comparison
Scenarios for GRAND ISLE
NOAA2017 VLM: 0.02320 feet/yr
All values are expressed in feet

Year	NOAA2017 VLM	NOAA2017 Low	NOAA2017 Int-Low	NOAA2017 Intermediate	NOAA2017 Int-High	NOAA2017 High	NOAA2017 Extreme
2000	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2010	0.23	0.33	0.36	0.43	0.52	0.59	0.59
2020	0.46	0.69	0.75	0.89	1.02	1.12	1.18
2030	0.70	1.05	1.15	1.38	1.57	1.80	1.94
2040	0.93	1.41	1.54	1.87	2.20	2.56	2.79
2050	1.16	1.77	1.94	2.43	2.92	3.51	3.90
2060	1.39	2.13	2.33	3.05	3.77	4.63	5.25
2070	1.62	2.46	2.72	3.67	4.69	5.87	6.73
2080	1.86	2.82	3.15	4.40	5.71	7.25	8.37
2090	2.09	3.12	3.54	5.12	6.82	8.73	10.30
2100	2.32	3.44	3.87	5.87	8.07	10.40	12.40

Revised 11 February 2021

Figure 17: USACE Sea Level Adjustment Values for Grand Isle

4.2 Models (10, 25 and 100-year events using a hydrograph approach)

In order to perform a hydrograph-type assessment of the future conditions, the current Parish EPA SWMM models for the Jefferson Eastbank Polder and the Catouatche Polder were adjusted to reflect future parameters. Future conditions were checked for use of the NOAA Atlas 14 storm and for use of varying future sea levels corresponding to the NOAA 2017 Intermediated years 2075 and 2100 and the NOAA 2017 Int-High year 2100 at the outfalls for both Polders. For the Catouatche Polder use of subcatchment future development impervious area conditions corresponding to the Parish future land use mapping were utilized to assess flood impacts to the polder.

For the Jefferson Eastbank Polder, the current subcatchment impervious factors for existing conditions was used as the model impervious parameter. The models were run for existing conditions to establish the basline water surface and hydrographs for the study areas. Runs were performed for the 10-year, 25-year, and 100-year storm events with rain parameters denoted in Figure 13.

Subcatchment impervious factors, conduit size and lengths, and junction inverts and rim elevations were used as presented in the Parish models. Model values for tailwater elevations at the outfalls were used as presented in the Parish model or adjusted to reflect the values used in the RAS models used to develop the FIRM elevations which were based on Adcirc modeling of Lake Ponchartrain. Additional descriptions of the SWMM model outputs are provided in Appendix A. Additional description of the hydrograph modeling methods is provided in Appendix B.

In consideration of the impact on duration of inundation due to sea level rise, hydrographs were developed for a junction (JC1) located in the Jefferson Eastbank Polder, near the northwest Lake Ponchartrain Levee, at the canal situated at the corner of Yenni Boulevard and Platt Drive. The existing condition hydrograph was plotted and the high sea level hydrograph was superimposed on the existing condition plot for comparison. This comparison was made for the 10-year and 100-year, TP-40 storms with an intermediate year 2100 sea level rise and the hydrographs are shown in Figure 26 and Figure 27, respectively.

To provide metrics on the increased pump use associated with a projected seal level rise and increased NOAA Atlas 14 100-year storm-intensity-duration, pump utilization and power usage parameters were compared for existing and future conditions in the Jefferson Eastbank Polder. The SWMM model has a total of 64 pumps, not including three Harahan pump-to-the-river pumps. The “Utilized Percent” metric was derived by taken average “utilized percent” paramenter for all of the 64 pumps. The “Power Usage” in kwatt-hrs was derived by comparing total power usage of the 64 pumps for the existing and future conditions. The comparative current and Year 2100 conditions are shown in Figure 28.

Future Conditions Flood Impacts

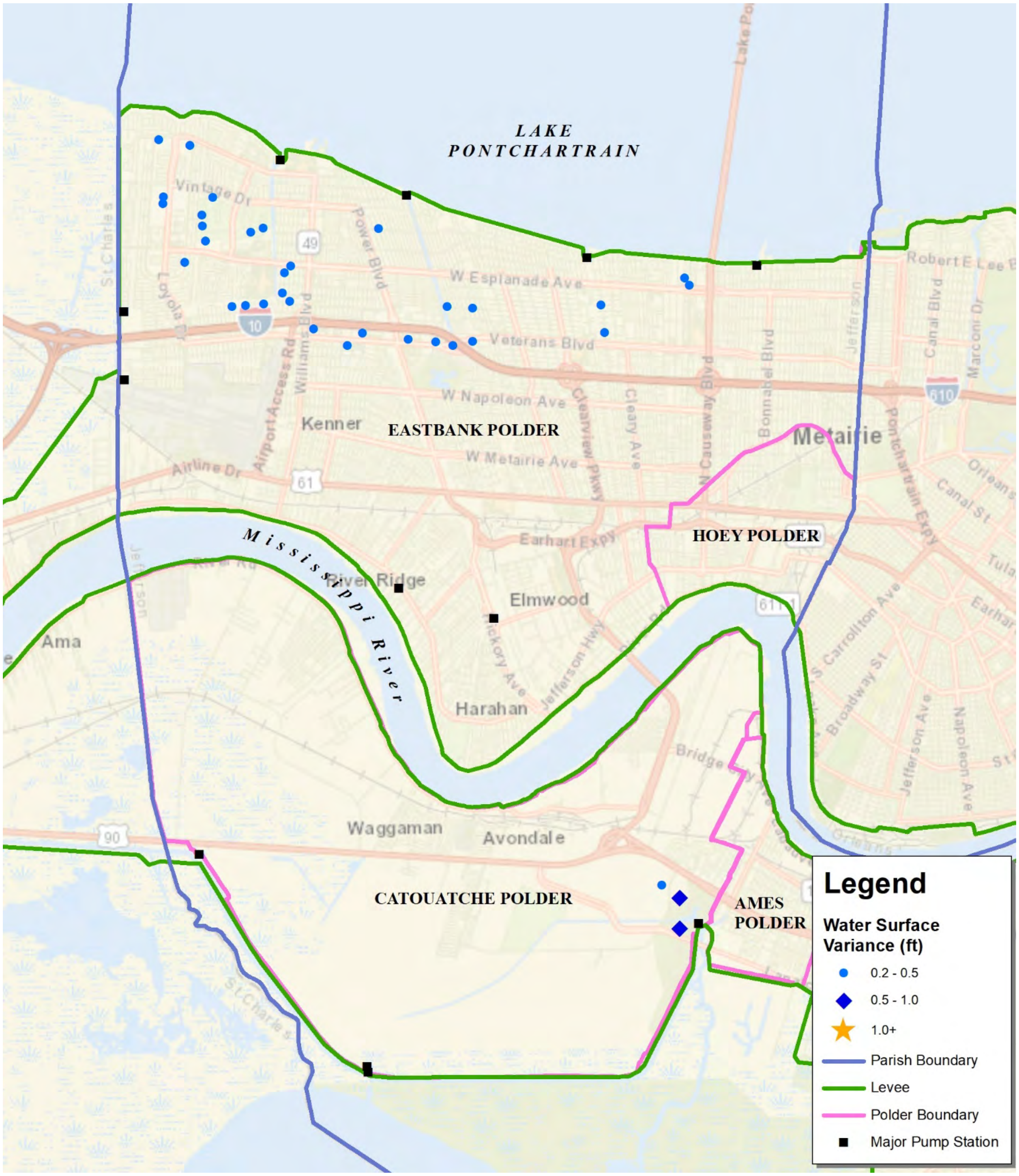

Figure 18: 10-Year Flood Impact Due to 8.07-ft Sea Level Rise

Future Conditions Flood Impacts, continued

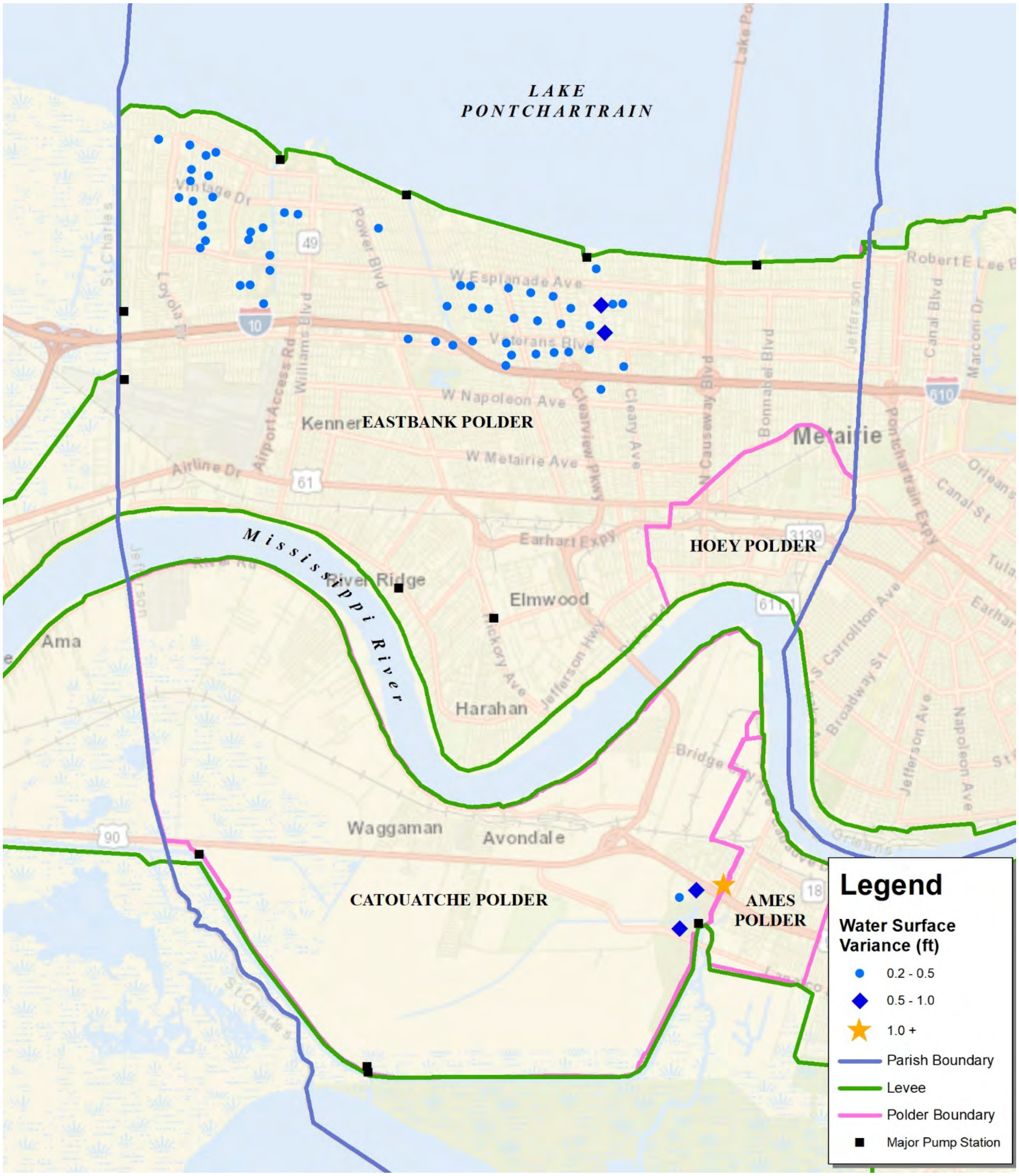

Figure 19: 25-Year Flood Impact Due to 8.07-ft Sea Level Rise

Future Conditions Flood Impacts, continued

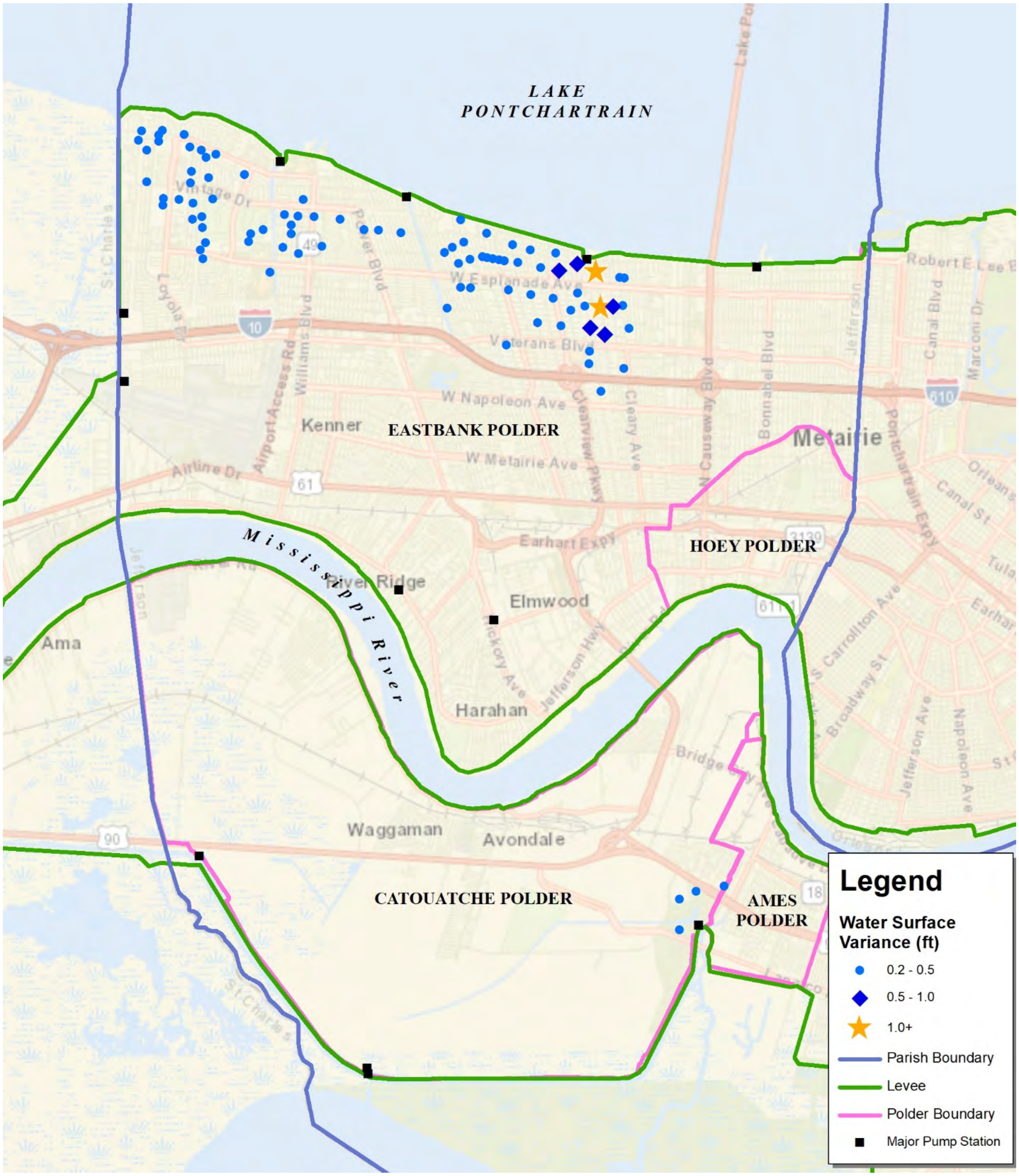

Figure 20: 100-Year Flood Impact Due to 8.07-ft Sea Level Rise

Future Conditions Flood Impacts, continued

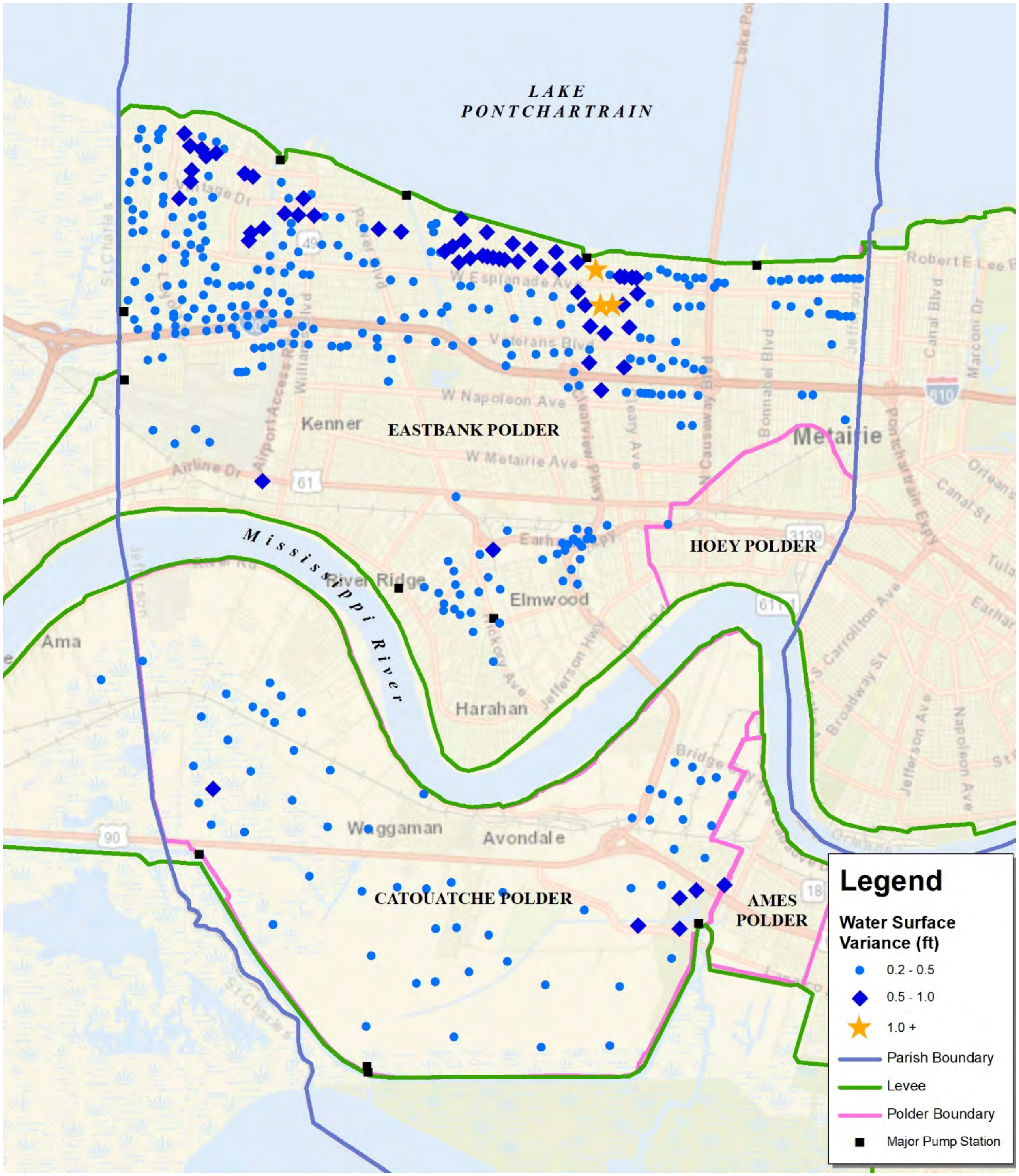

Figure 21: 100-Year Flood Impact Due to 8.07-ft Sea Level Rise and NOAA Rain Intensity

Future Conditions Flood Impacts, continued

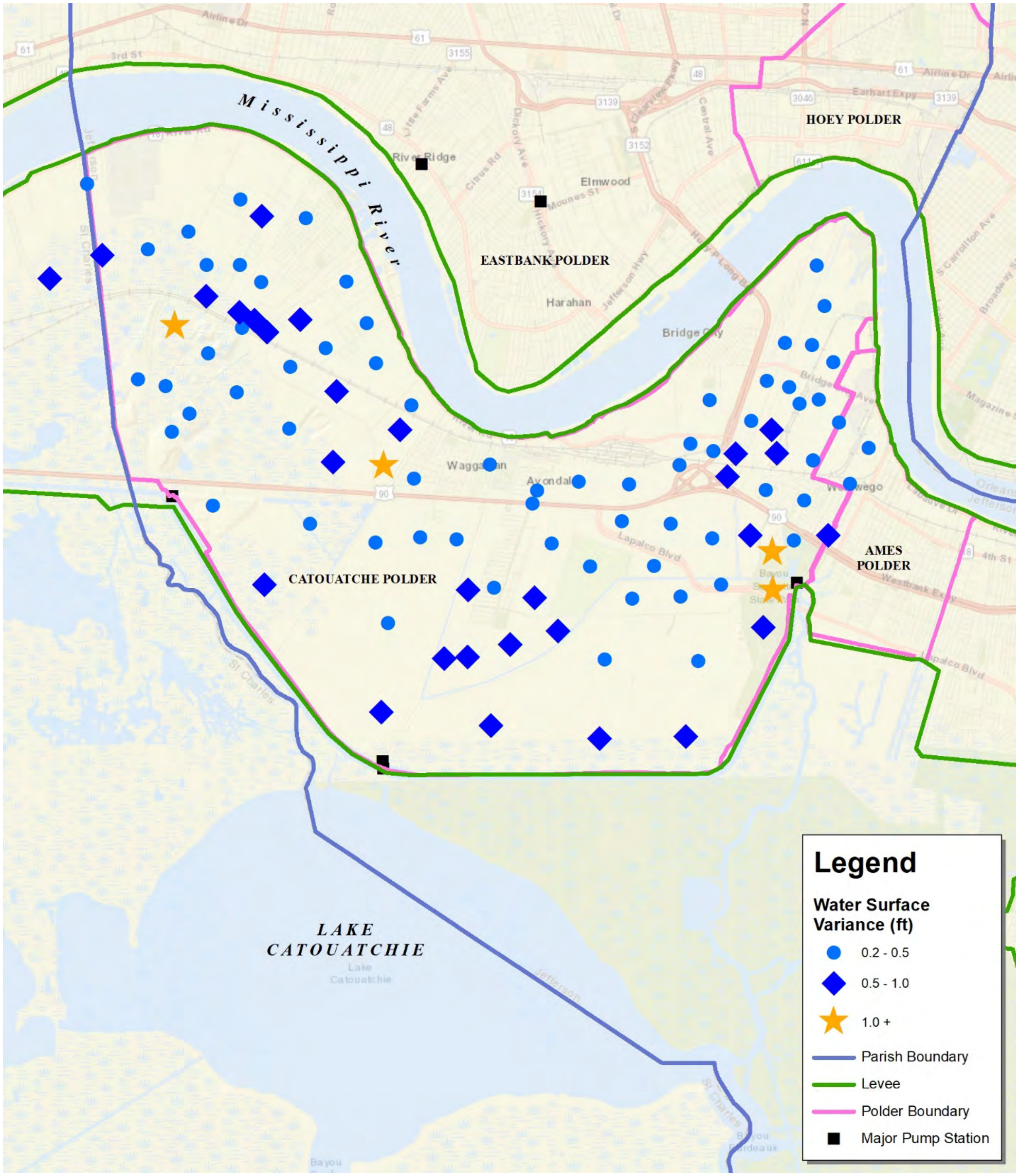

Figure 22: 10-Yr Flood Impact Due to Development in Catouatche Basin

Future Conditions Flood Impacts, continued

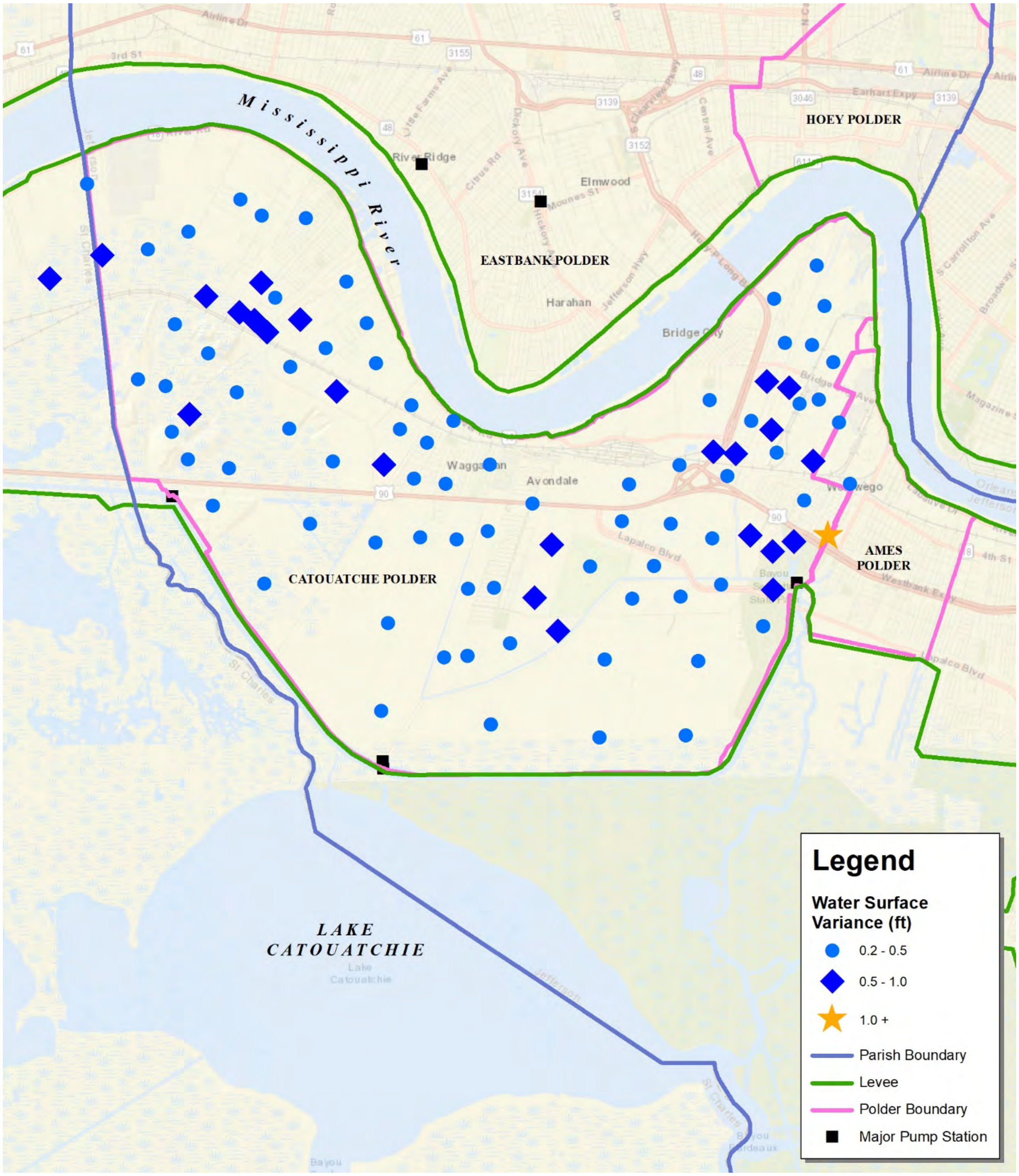

Figure 23: 25-Yr Flood Impact Due to Development in Catouatche Basin

Future Conditions Flood Impacts, continued

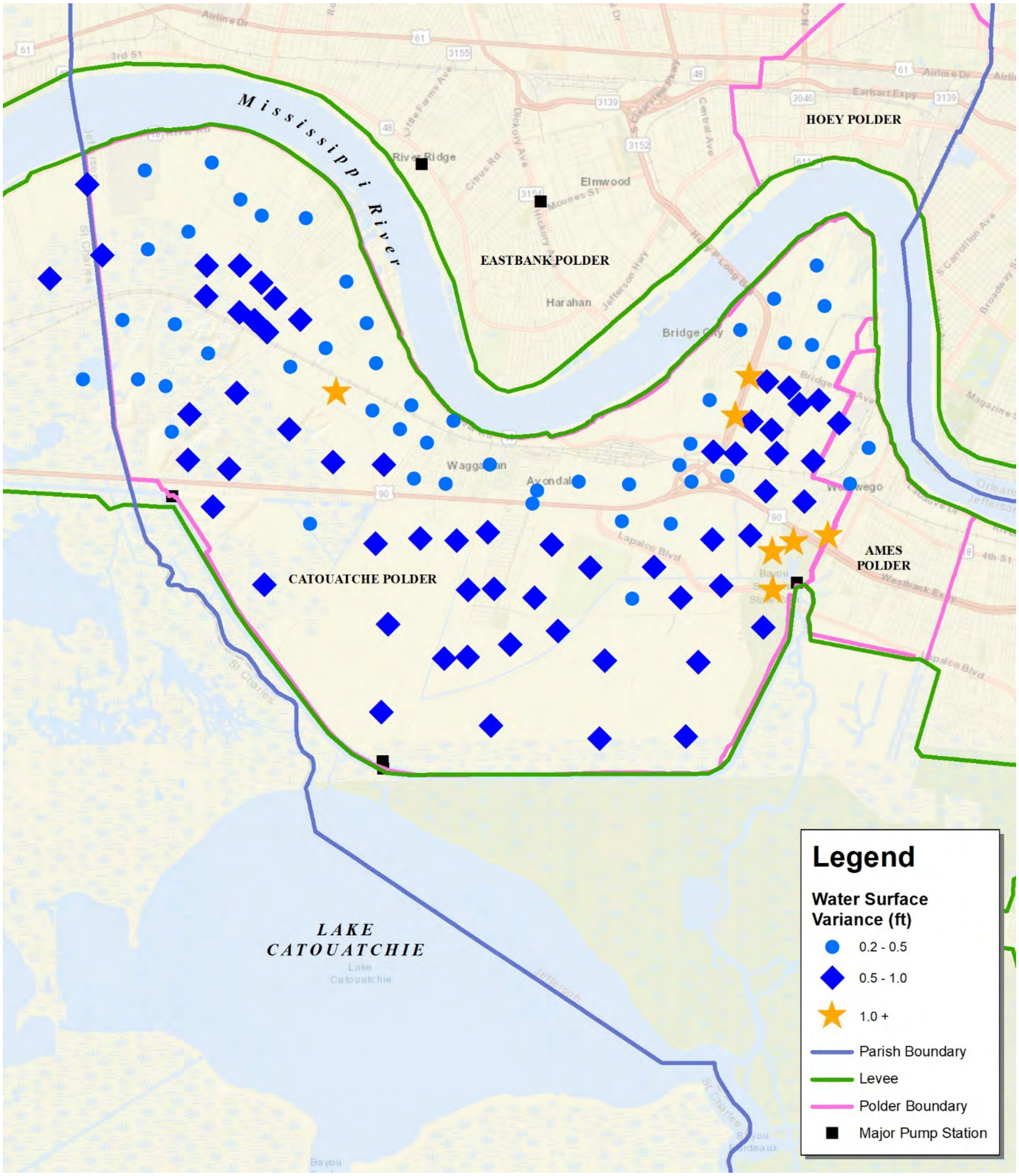

Figure 24: 100-Yr Flood Impact Due to Development in Catouatche Basin

Future Conditions Flood Impacts, continued

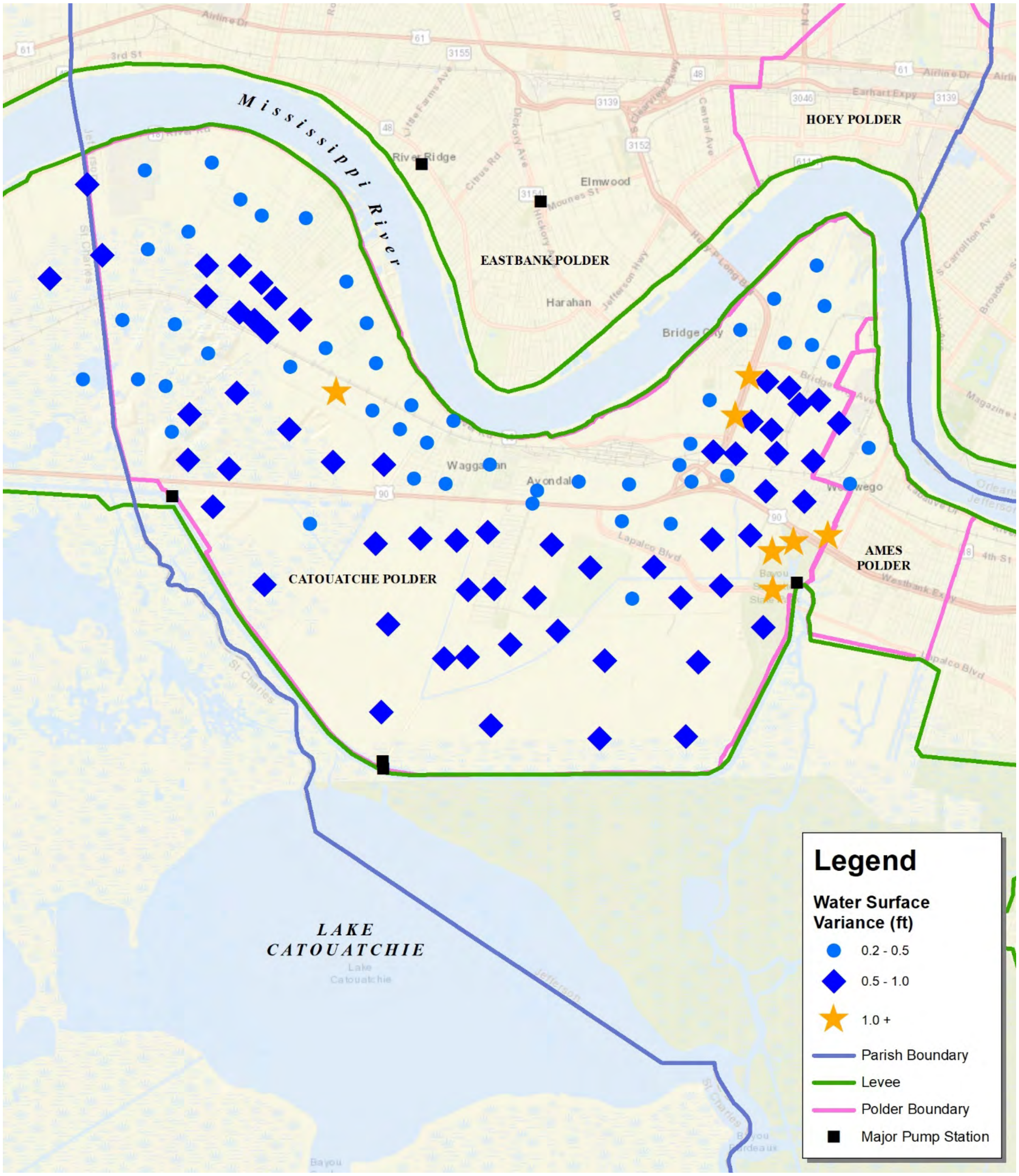

Figure 25: 100-Yr Flood Impact Due to Development, 8.07-ft Sea Level Rise, and NOAA Rain Intensity Adjustment

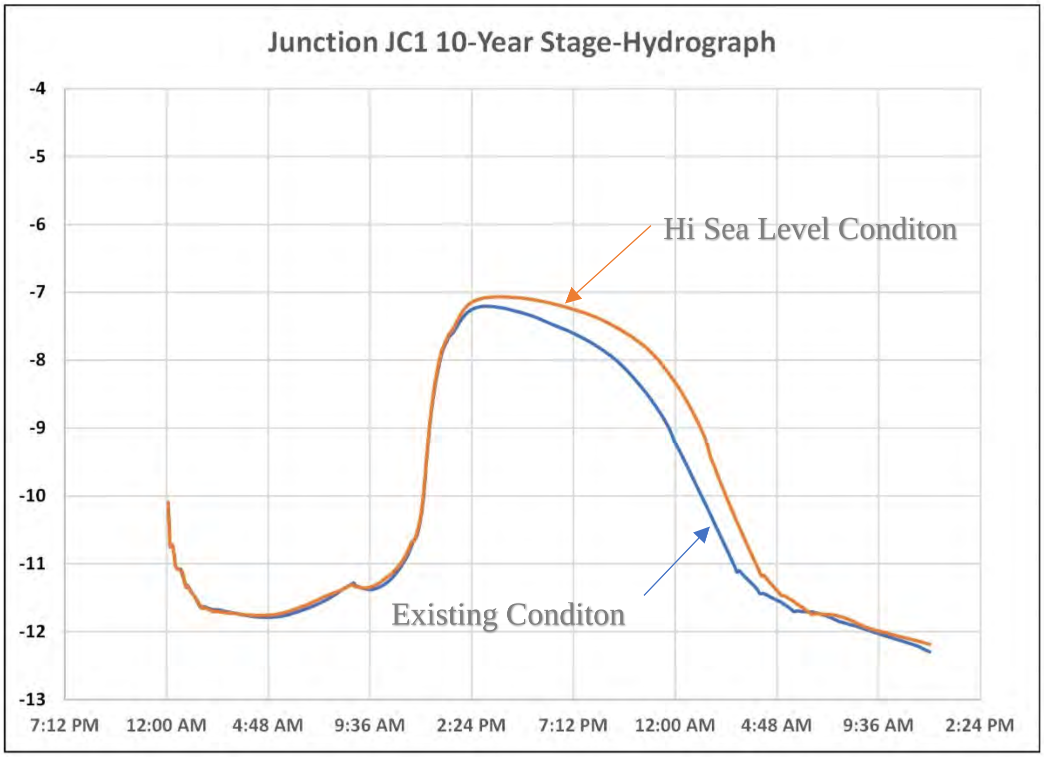

Figure 26: Comparative 10-Yr Stage-Hydrographs at Platt St and Yenni Boulevard

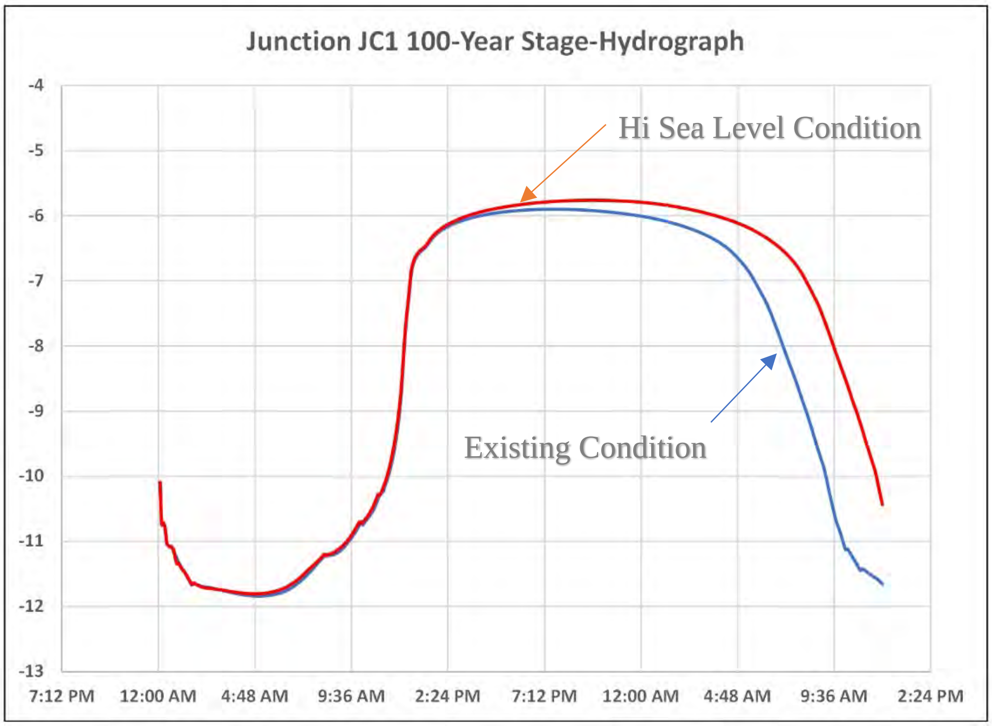

Figure 27: Comparative 100-Yr Stage-Hydrographs at Platt St and Yenni Boulevard

Condition of Storm and Sea Level		Utilized (%)	Power Usage kwatt-hrs	Power Usage Percentage Increase
Technical Paper 40 - 100 Yr Storm; Existing Sea Level *1		48.2%	393699	
NOAA Atlas 14 - 100 Yr Storm; 5.87-ft Sea Level Rise *2		58.8%	567327	
Increase		10.6%	173629	44.1%
*1 Model: Jeb_Swmm_Tp40_RasTw_100_210201a1				
*2 Model: Jeb_Swmm_Noaa_RasTW+5p87_100_210201a1				

Figure 28: Jefferson Eastbank Polder 100-Yr Pump Utilization and Power Usage

4.3 Identification of Issues

- Pump Conditions for high sea-level "tailwater" conditions
- Adoption of higher intensity NOAA Atlas 14 Storm impacts on water surface values in the FIRM map determinations.
- Redevelopment in Jefferson Eastbank which may increase impervious area or loss of storage unless use of Green Infrastructure principals are employed in redevelopment.
- Increase in water surface due to development to Land Use Plan conditions in Catouatche Polder without compelling use of Green Infrastructure principals in development.
- Updating of EPA SWMM models to reflect additional pumps and canal improvements.
- Non-uniform water surface increases for storm events greater than the 100-year because of levee ratings.

5.0 Alternative Analysis

Alternative analysis considers how land use/stormwater regulations, detention, and redevelopment regulations affect future conditions. Detention considerations include specific actions which can be imposed upon developers to mitigate increased rates and volumes of runoff.

5.1 Land Use/Stormwater Regulations Effect on Future Conditions

Stormwater management is an evolving issue. As development continues at record levels, the quantity and rate of storm runoff is an issue that needs to be looked at carefully in integrated land use planning and environmental planning, in order to balance environmental, social, and economic needs. The challenge of how to better handle storing, and monitoring the stormwater runoff from development without upgrading local drainage infrastructure is shifted to the private sector through regulations.

Land use and stormwater regulations that call for maintaining the hydrologic cycle and focus on preventing the increased risk of flooding affect future conditions for residents and developments in a watershed. A common approach to maintaining the hydrologic cycle is to specify that post-development infiltration must be equal to the pre-development infiltration. The quantity of water that must be infiltrated via stormwater controls, to compensate for vegetation changes and increased imperviousness, can be estimated using a range of techniques from equations to computer models. To prevent an increased risk of flooding, it is usually specified that maximum peak flows (or volumes per unit time) must not exceed predevelopment values for large storms. Large storms include the 2, 5, 10, 25, and 100-year storms

5.2 Detention/Conveyance Effect on Current and Future Issues

Peak flows are controlled by detaining runoff so that it does not reach the stream within a relatively short time period during or soon after a storm. However, care must be taken so that detained runoff from different parts of the watershed does not arrive at the same location at the same time. Generally, holding runoff longer in the upper parts of a watershed will ensure that this does not happen. Specific application of green infrastructure features can be analyzed for timing impacts of detaining runoff by analysis with computer simulations of the flow timing affects of the features.

Specifying the use of green infrastructure features, which the EPA SWMM model identifies as “low impact development features”, or LIDs, can be used to mitigate increased rates and volumes of runoff associated with development. SWMM can explicitly model eight different generic green infrastructure practices:

- Continuous Permeable Pavement Systems
- Rain Gardens
- Bioretention Cells (or Bioswales)
- Vegetative Swales
- Infiltration Trenches
- Green Roofs
- Rooftop (Downspout) Disconnection
- Rain Barrels or Cisterns (Rainwater Harvesting)

Descriptions of the green infrastructure or EPA low impact development (LIDs) follow:

	**SWMM LID - Continuous Permeable Pavement Systems** Permeable pavement allows rainfall to immediately pass through the pavement into the gravel storage layer below where it can infiltrate at natural rates into the site's native soil. In block paver systems, rainfall is captured in the open spaces between the blocks and conveyed to the storage zone and native soil below.

	**SWMM LID - Rain Gardens** Rain gardens are depressed areas, planted with grasses, flowers, and other plants, that collect rain water from a roof, driveway, or street and allow it to infiltrate into the ground. More complex rain gardens are often referred to as bioretention cells.
	**SWMM LID - Bioretention Cells (or Bioswales)** *Bioretention cells are depressions containing vegetation grown in an engineered soil mixture placed above a gravel drainage bed that provide storage, infiltration, and evaporation of both direct rainfall and runoff captured from surrounding areas.*
	**SWMM LID - Vegetative Swales** *Vegetative swales are channels or depressed areas with sloping sides covered with grass and other vegetation that slow down the conveyance of collected runoff and allow it more time to infiltrate the native soil beneath it.*
	**SWMM LID - Infiltration Trenches** *Infiltration trenches are narrow ditches filled with gravel that intercept runoff from upslope impervious areas. They provide storage volume and additional time for captured runoff to infiltrate the native soil below.*
	**SWMM LID - Green Roofs** *Green roofs are a variation of a bioretention cells that have a soil layer atop a special drainage mat material that conveys excess percolated rainfall off of the roof. They contain vegetation that enable rainfall infiltration and evapotranspiration of stored water.*
	**SWMM LID - Rooftop (Downspout) Disconnection** *This practice allows rooftop rainwater to discharge to pervious landscaped areas and lawns instead of directly into storm drains. It can be used to store stormwater (e.g., in a rain barrel) and/or allow stormwater to infiltrate into the soil (e.g., into a rain garden or lawn).*

SWMM LID - Rain Barrels or Cisterns (Rainwater Harvesting)

Rain barrels and cisterns are containers that collect roof runoff during storm events and can either release or re-use the rainwater during dry periods. Cisterns may be located above or below ground and have a greater storage capacity than a rain barrel.

5.3 Redevelopment Regulation Considerations

Redevelopment is an important consideration for the Eastbank Polder. There are a number of factors that must be considered in redevelopment to avoid changes in the water surface to the property owners upstream and downstream from the development. These issues include:

- No increase in peak runoff or volume of runoff for sustained period.
- Elevation considerations for freeboard for new construction due to higher intensity NOAA 100-Yr design storms.
- Restrictions on increasing slab footprint in residential areas.
- Restrictions on converting pier type foundations to slab foundations.
- Parking lot additions and replacement restrictions on pavement type (permeable) and runoff mitigation using other green infrastructure appurtenances.

6.0 Recommendations

The objective of stormwater management, as described by CRS Coordinator's Manual, is to prevent future development from increasing flood hazards to existing development, to protect existing hydrologic functions within the watershed, and to maintain and improve water quality. Because of the wide interpretation given to this term, the CRS does not use the words "green infrastructure" in its credit criteria. However, the CRS does provide credit for designated open space corridors or connected networks that maintain natural ecological processes, and sustain water resources. In these recommendations the wide interpretation of "green" is narrowed to principles consistent with stormwater management goals. It may be noted that CRS and EPA are not consistent with the use of the term "green" infrastructure.

The following recommendations are based on issues identified in modeling the existing conditions and future conditions, and on consideration of Jefferson Parish flood mitigation features and program management critical to the resiliency of the stormwater control systems. Jefferson Parish has a special reliance on canal, pump, and levee infrastructure which is included as a consideration because of the importance of management of these features to accommodate changing sea levels and changing storm intensities. Additionally, select recommendations from the "NFIP CRS Credit for Stormwater Management" that were considered applicable to Jefferson Parish are included.

6.1 Capital Improvement Program

1. **Increase the capacity of pumping systems and generator systems.**

   Capacity increases should provide for additional wear and tear on the pumping system associated with longer run times caused by rising sea levels. This upgrade is recommended for both the Eastbank Polder and the Catouatche Polder based on hydrograph analyses performed in this plan. By extension, upgrades for the other polder system pumps and generators are recommended. Based on an intermediate-high sea-level rise of up to 8.07-ft projected to occur by the year 2100, intake canal capacities and canal reaches in the proximity of the pump station should be evaluated for needed expansion associated with increased pump capacity.

2. **Expand the use of Pump-to-the-River strategies.**

   Pump-to-the-river systems increase the overall system pump capacity and reduce the storm runoff burden on the south-to-north canal system on the Eastbank. Neighborhood station systems and larger area systems, such as the Hoey Basin and south Harahan area, should be evaluated for their supplemental value. Investigate pump-to-the-river system potential on the Westbank polders.

3. **Maximize the use of low-impact development facilities.**

   Before construction of any "hard" facilities, implement green infrastructure principles such as the use of bio-retention facilities, rain gardens, rain barrels, preserving and recreating natural landscape features, separating roof drains, and minimizing effective impervious areas to create functional and appealing mitigation of site drainage peak flow and volume increases to mitigate future redevelopment and development.

4. **Ensure capital improvements plan incorporates future development and redevelopment.**

   Continue the development and implementation of a capital improvements plan prior to development in areas where future development or redevelopment is projected to increase peak storm flows or storm runoff volume. Base the capital improvements on hydrograph methodology design in a manner to handle any increase in flow rates and volumes for the 10, 25, and 100-year events, and prevent increased downstream flooding. This recommendation is especially applicable to the Catouatche Polder.

5. **Work with state and federal partners for external levee system maintenance and upgrades.**

   Continue performance and readiness review of the external system of levees and flood control structures under the purview of the East and West Jefferson Levee Districts, and the Southeast

Louisiana Regional Flood Protection Authority which oversee the local levee districts to ensure the impacts of an intermediate-high sea-level rise of up to 8.07-ft projected to occur by the year 2100 are incorporated into future design criteria as applicable.

6. Consider opportunities to advance compartmentalizing polders.

Research development of the existing "polder" system to further enhance the existing system of compartmentalized flood protection "polders," or internal levees, that would limit the extent of flooding, including in the event of a levee failure.

7. Plan for increased flood protection to a 500-year standard.

As demonstrated in the 2018 FEMA FIS there is an extreme difference in flood water surface between the 100-year event storm water surface and the 500-year storm water surface which exceeds 12-ft in many areas; considering projected rising sea levels of nearly 6-ft; and considering that over a twenty-year period the probability of a 100-year event is more than 1-in-6 (the likelihood of rolling a seven with a pair of dice), there is an apparent need to improve the flood protection system risk reduction.

6.2 Regulatory Revisions or Reinforcements

1. Stormwater Management Regulation Revisions

Continue development of clear and explicit stormwater management regulations that require specific actions or standards from a developer engaged in development and redevelopment to ensure that peak flows for the 10-year, 25-year, and 100-year storm events are not increased. For example, language should provide a statement as follows, "For all development, except a single-family residence, the applicant shall provide a stormwater management system that prevents any increase in flow for the 10-year, 25-year, and the 100-year design storms." The Parish Green Infrastructure plan should be consulted for specific requirements in relation to soil type and location.

2. Consider storm impact mitigation and fill prohibition

Include controlling the volume of runoff to predevelopment conditions for the 10, 25, and 100-year storms in design criteria ordinances as part of storm impact mitigation. Identify land areas where ordinances should be imposed to prohibit fill without mitigation for development involving new structure foundations, or redevelopment foundation expansion, or replacement of pier foundations with slabs. Similarly, identify areas where streets in new developments should be constructed of permeable pavement with base material uniformly graded to provide retention basin value.

3. ### 100-year Design storm using NOAA Atlas 14

   Base the 100-year design storm for design in the polder areas within the HSDRRS upon the NOAA Atlas 14 rainfall intensity predictions of 14.4-inches in 24-hours. The Parish intensity predictions for the more frequent events should be reviewed to determine the appropriate rainfall intensity, and intensity values should be no less than the NOAA Atlas 14 projections. Considering the extreme latitude difference between the north portion of the parish and the south portion, consideration for variance in the rainfall intensity between the north and south portions of the Parish is recommended.

4. ### Private detention/retention inspection and authority

   Ensure that there are provisions to give the Parish the legal authority to inspect private detention or infiltration facilities. It is recommended to require owners to perform appropriate maintenance when necessary, and, where applicable based on a determined standard, to require that detention facilities be dedicated to the community.

5. ### Adopt qualifying ordinances that prohibit development, alteration, or modification of existing natural channels.

   Where channel improvements are necessary to increase flow capacity, it is recommended that the Parish adopt design standards to require channel improvement projects use natural or "soft" approaches rather than gabions, rip rap, concrete, or other "hard" techniques in drainageways where the drainageway has sufficient width.

6. ### Provide a dedicated funding source for implementation of the watershed management plan.

   Consider use of a percentage of the dedicated drainage millage to provide funding for administrative and some facility features associated with implementation of the management plan.

7. ### Incorporate municipalities into watershed planning

   Continued cooperation with incorporated communities within Jefferson Parish in the management of stormwater, review of the watershed management plan, and the stormwater management regulations to ensure that the various jurisdictional regulations are consistent.

8. ### Perform periodic updating of the watershed master plan to ensure the plan is no more than five years old.

   The Parish must certify that the plan is still applicable and not obsolete for successive five-year periods to maintain CRS credit for the plan. The parish should re-evaluate sea-level rise predictions at each period update to ensure the plan has the most up-to-date predictions.

9. ### Continue and enhance community outreach educating residents of the importance of flood insurance and pro-active measures property owners can take to reduce community flood impacts.

Continue, expand, and publicize existing programs such as the Parish Floodplain Management & Hazard Mitigation web page: (*https://www.jeffparish.net/departments/floodplain-management---hazard-mitigation*). Develop educational brochures that explain green infrastructure features such as rain gardens, rain barrels, vegetative swales, and rooftop downspout disconnects.

6.3 Land Use Identification Modifications

1. ### Parks and Recreation facilities

Identify parks and recreation facilities that can be designated stormwater mitigation areas. Develop green infrastructure appurtenances and maintenance plans for storm water routing to maximize detention and groundwater recharge based on hydrograph design methods in a manner to reduce flood water stages and durations.

2. ### Wetlands and Open Space areas

Identify existing wetlands or other natural open space areas to be preserved from development so that natural attenuation, retention, or detention of runoff is provided. The runoff and flood damage as well as other floodplain management benefits of these areas should be documented and the areas should be mapped, and regulations implemented to preserve the identified areas.

7.0 Summary

This Watershed Management Plan (WMP) provides an assessment of how flood stages will be affected by projected changes in future rain and sea-level conditions and by redevelopment and new development in the Jefferson Parish area watersheds. The plan is organized to satisfy the requirements for the Community Rating System Activity 450: Storm Water Management. Green infrastructure features which should be implemented at the community or individual property owner level are included to provide low impact development methods to decrease peak runoff and runoff volume. Recommendations to provide a framework for strategies to facilitate implementation of the WMP are presented in the categories of “Capital Improvement Program”, “Regulatory Revisions or Reinforcements”, and “Land Use Identification Modifications”.

Based on FEMA recommended criteria, the Watershed Management Plan presents an analysis of the existing and future conditions on over 50-percent of the Parish inside the levees for 10-year, 25-year, and 100-year storm events using a hydrograph approach based on EPA SWMM model analysis. SWMM models of the Jefferson Eastbank Polder and the Catouatche Polder were analyzed individually. Comparative future conditions were assessed using Technical Paper 40 versus NOAA Atlas 14 rainfall intensity predictions and using current sea level versus NOAA's 2100 intermediate Sea Level Rise Projection which projects a 5.8-feet rise in sea level and NOAA 2017 Intermediate-High Sea Level Rise which projects an 8.07-feet rise in sea level. Future land use was based on the newly updated Jefferson Parish Comprehensive Plan, Envision Jefferson 2040 land use information. Parish EPA SWMM numerical hydrologic-hydraulic models were used in assessing impacts.

The model analysis indicated that the existing pump system has sufficient capacity to maintain near-present water surfaces in spite of rising sea levels, but the percent utilization and power usage are increased so that maintenance wear and tear, and power provisions should be considered. Considering storm intensity revisions as standard rain intensities are adjusted from historic Technical Paper 40 intensities to the more current NOAA Atlas 14, the values Jefferson Parish uses for 10- and 25-year storms already exceed NOAA Atlas 14 storm intensities. However, the 100-year NOAA storm is 1.4-inches greater than the Technical Paper 40 value used such that associated water surface impacts should be considered in order to anticipate future revision of the flood plain mapping. The storm water surface impacts due to development in the Catouatche Polder were found to be substantial if the area is built out to the future land use plan without mitigation or canal and pump capacity upgrades.

Implementation of the WMP recommendations contained herein is considered feasible in the short term and long term. Many of the recommendations are already in the process of implementation and other recommendations are complementary to existing drainage programs. Environmental and social benefits of the WMP include reduction of losses from flooding, and reduction of transportation facility flood depths and durations as well as enhance environmental and community sustainability through more extreme storm conditions. In addition to the community benefits of loss of damage, the implementation of these green infrastructure low-impact development features will provide substantial environmental and community benefits in the present and for the future.

8.0 References

1. National Flood Insurance Program, Community Rating System, CRS Credit for Stormwater Management, Edition 2020, FEMA, 27 pp.

2. National Flood Insurance Program, Community Rating System, Coordinator's Manual, FIA-15/2017, OMB No. 1660-0022 Edition: 2017, FEMA, 641 pp.

3. Flood Insurance Study, Jefferson Parish, Louisiana and Incorporated Areas, Revised February 2, 2018, FEMA FIS Study Number 22051CV000A, 95 pp.

4. Flood Insurance Rate Map, Jefferson Parish, LA and Incorporated Areas, Map Revised February 2, 2018, Map Nos: 22051C0120F, 22051C0115F, 22051C0180F, 22051C0185F, 22051C0190F, 22051C0195F, 22051C0250F, 22051C0235F, 22051C0095F, 22051C0160F, 22051C0175F, 22051C0215F, 22051C0220F, 22051C0255F, 22051C0260F, 22051C0275F.

5. Jefferson Parish Code of Ordinances: www.jeffparish.net/departments/planning/code-of-ordinances.

6. Envision Jefferson 2040: The Jefferson Parish Comprehensive Plan, as adopted on November 6, 2019, Prepared by Administration of Michael S. Yenni, Parish President, 173 pp.

7. Jefferson Edge 2020 Strategic Implementation Plan: Flood Protection, Prepared by JEDCO and GCR & Associates, Inc., 21pp.

8. Jefferson Parish, 2020 Multijurisdictional Hazard Mitigation Plan Update, June 2020, 893pp.

9. USGS, Dem Files, 2909006, 2909007, 2909014, 290915, 2909006, and 2909014.

10. Tiger Census for Jefferson, LA: tl_2019_22_tracts.shp.

11. Final Volume I, Comprehensive Environmental Document Phase I, Greater New Orleans Hurricane and Storm Damage Risk Reduction System, US Army Corps of Engineers, New Orleans District, May 2013, 676 pp.

12. US Army Corps of Engineers, New Orleans District Website: Missions/HSDRRS website: *www.mvn.usace.army.mil/Missions/HSDRRS/*

Appendix A: Water Surface Variance Due to Storm Class, Sea Level Change, and Development

List of Appendix A Figures **Page**

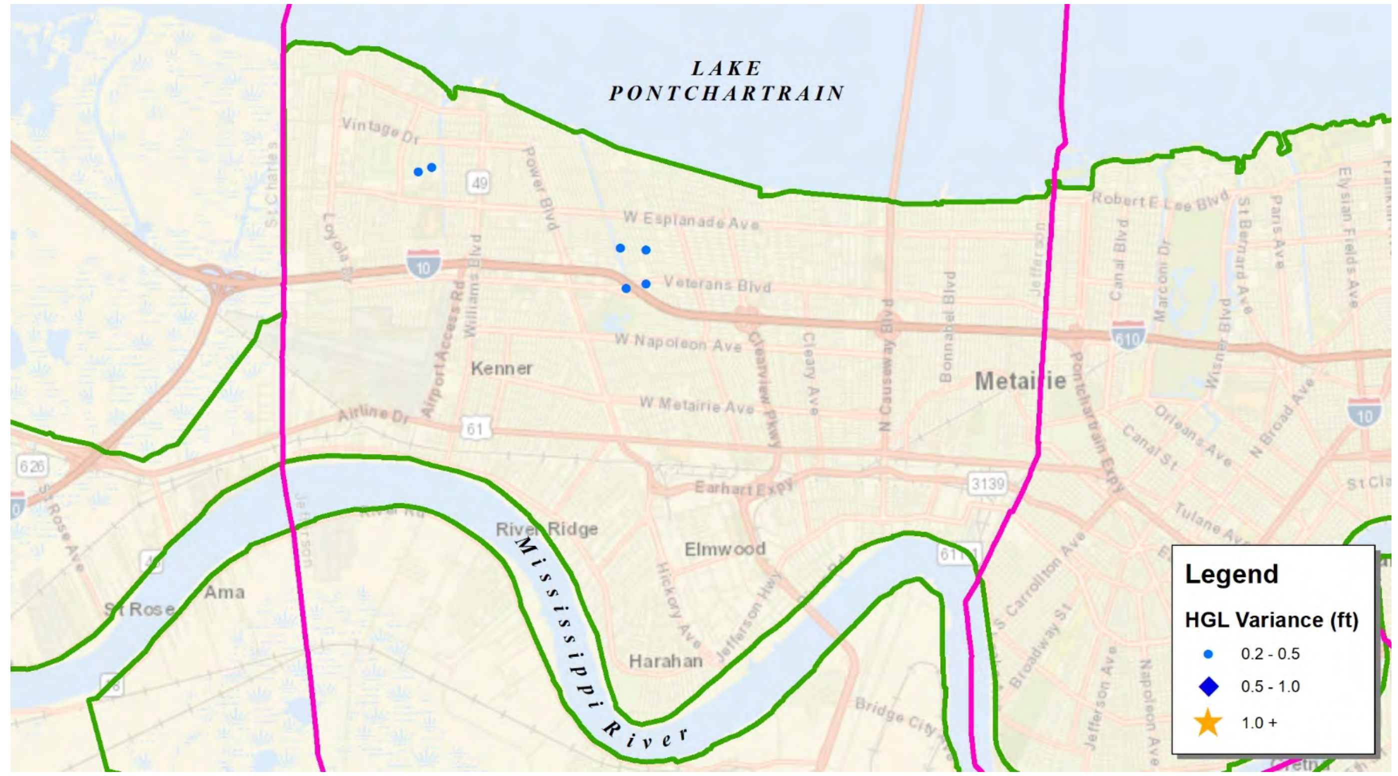

Figure A01: 10-Year TP-40 Storm, 4.0-ft Sea Level Rise

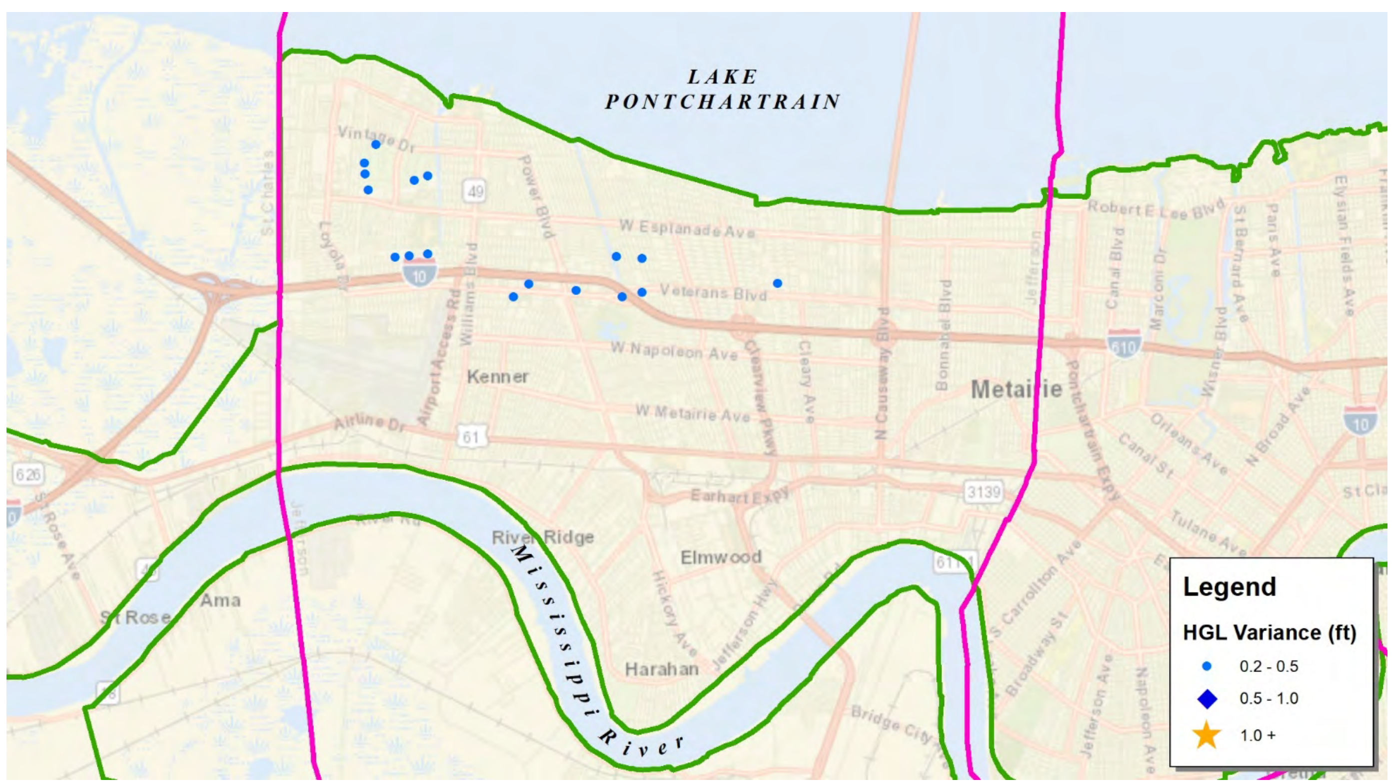

Figure A02: 10-Year TP-40 Storm, 5.9-ft Sea Level Rise

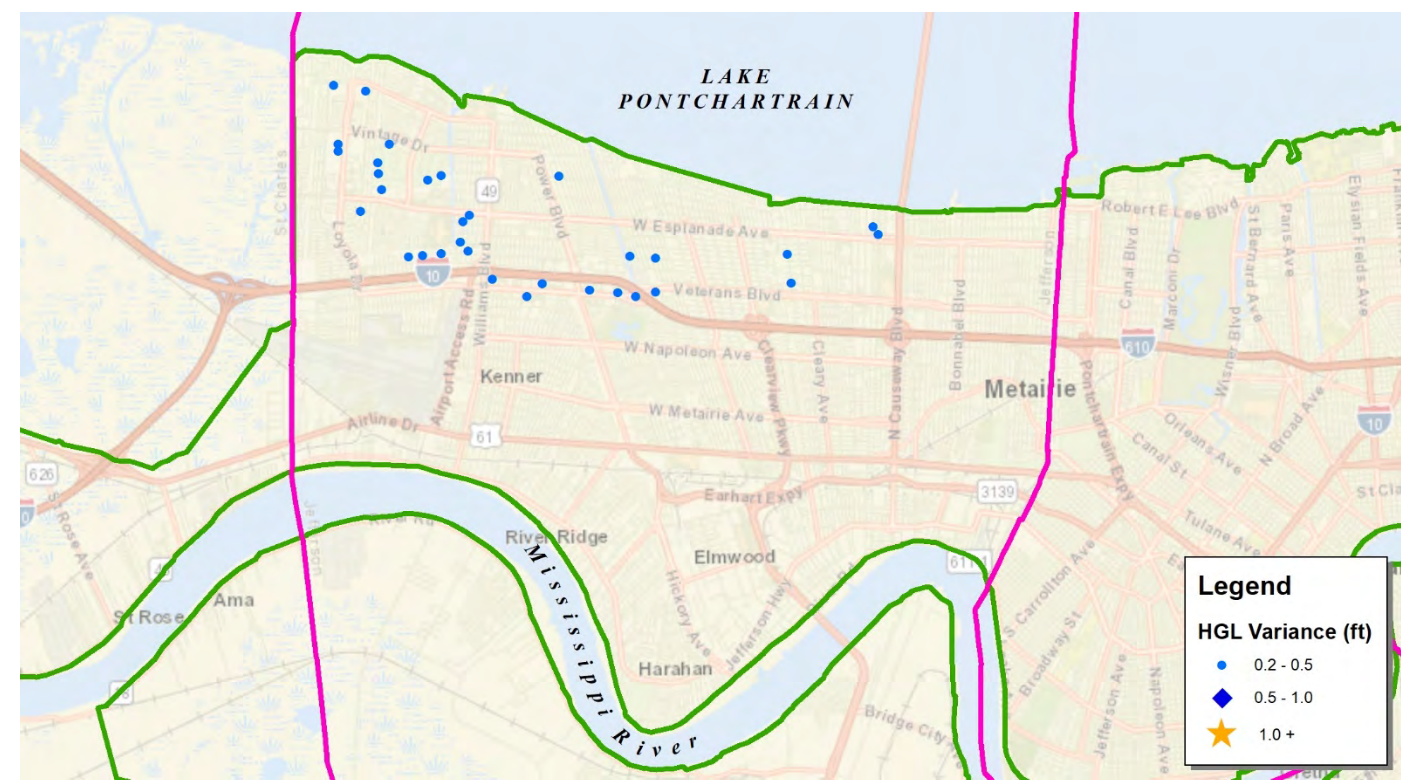

Figure A03: 10-Year TP-40 Storm, 8.07-ft Sea Level Rise

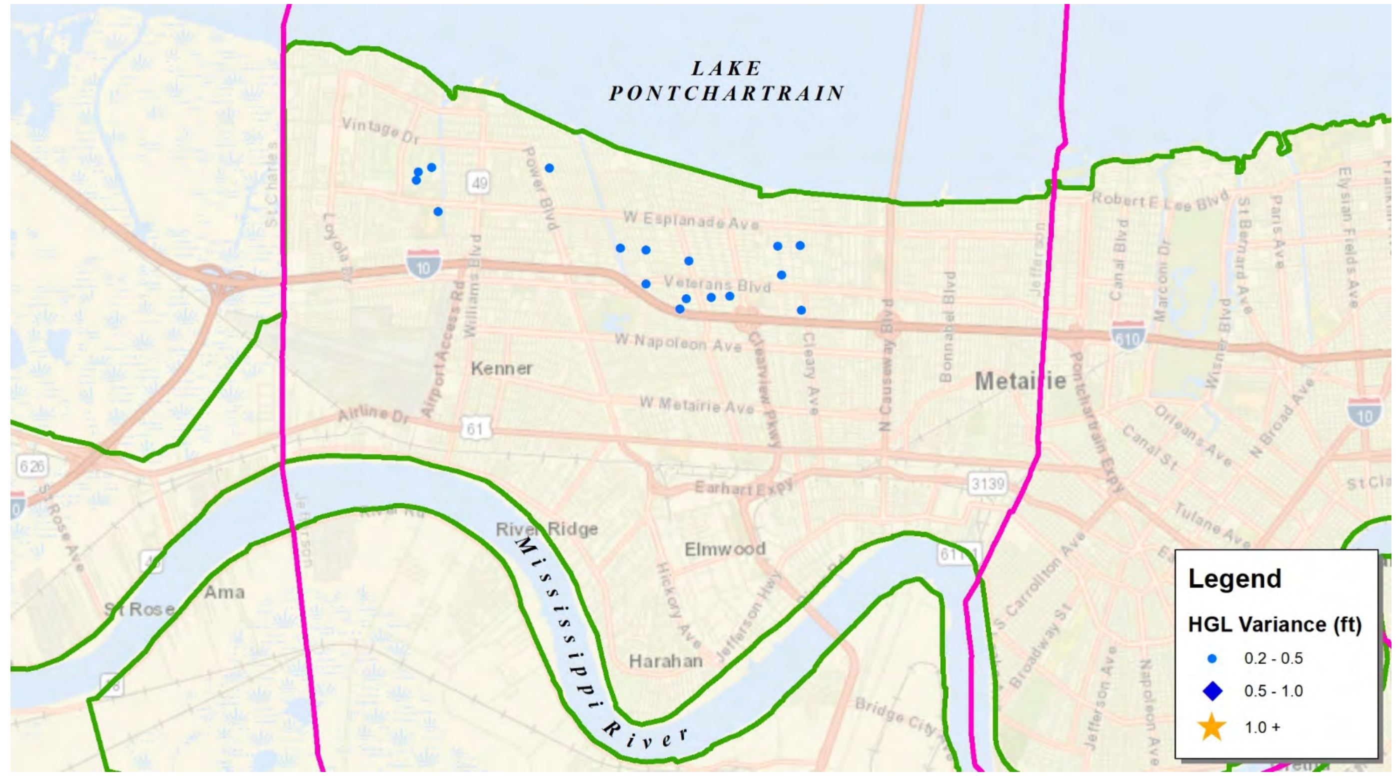

Figure A04: 25-Year TP-40 Storm, 4.0-ft Sea Level Rise

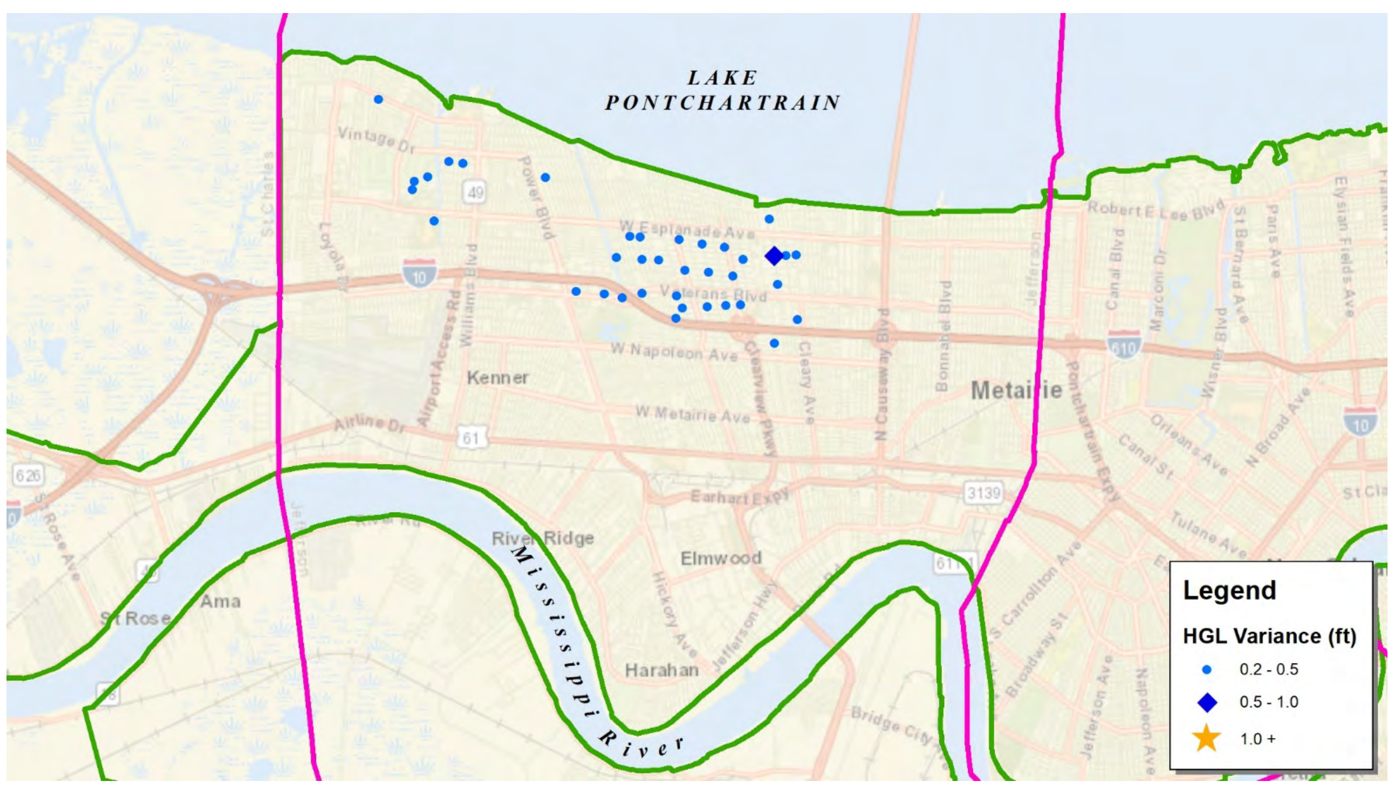

Figure A05: 25-Year TP-40 Storm, 5.9-ft Sea Level Rise

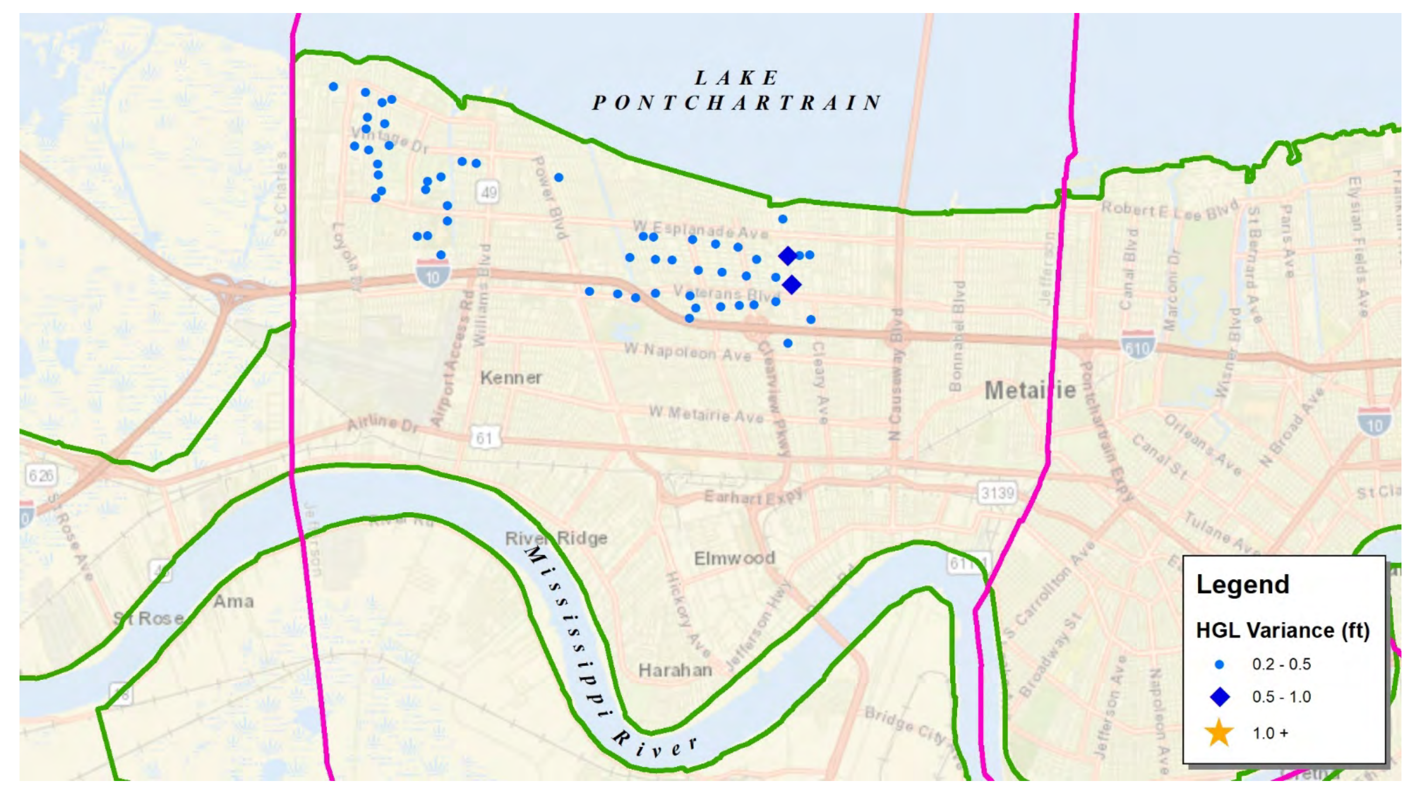

Figure A06: 25-Year TP-40 Storm, 8.07-ft Sea Level Rise

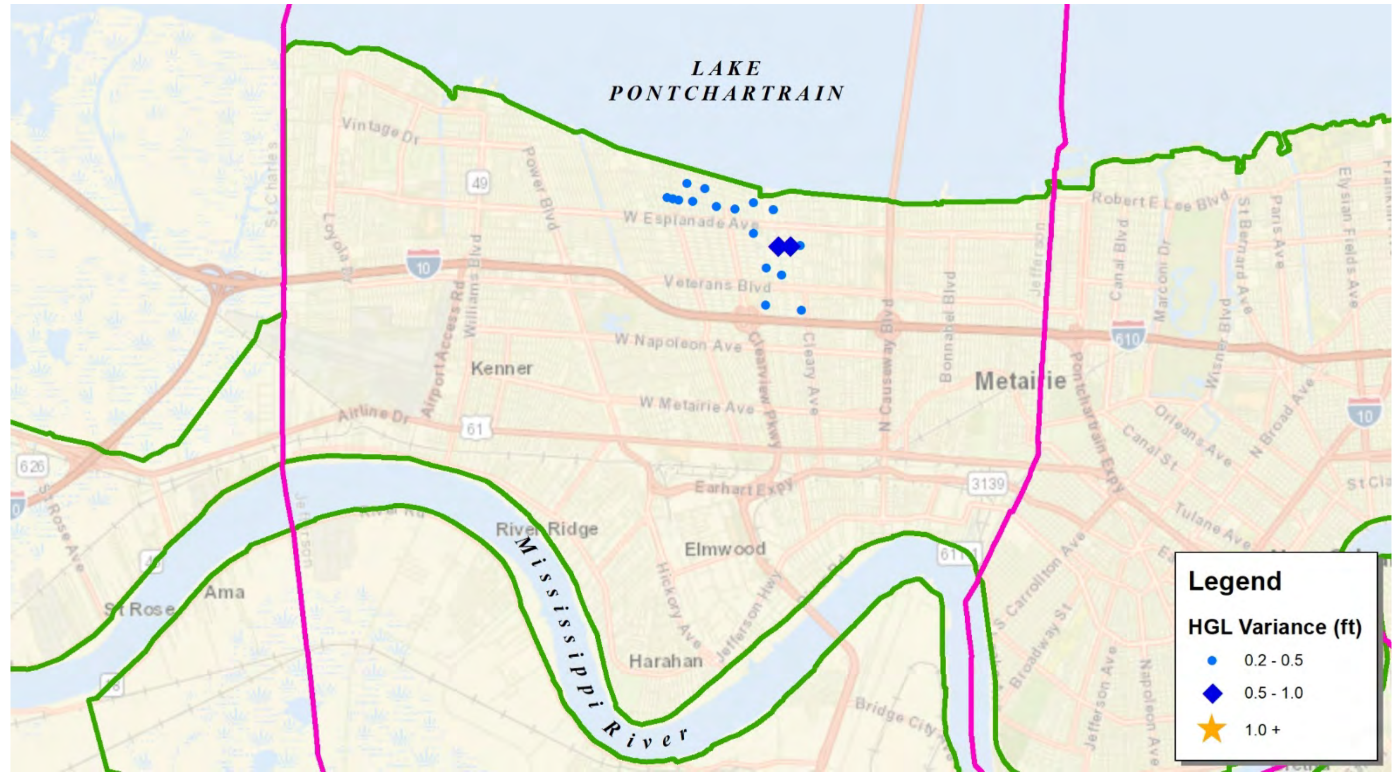

Figure A07: 100-Year TP-40 Storm, 4.0-ft Sea Level Rise

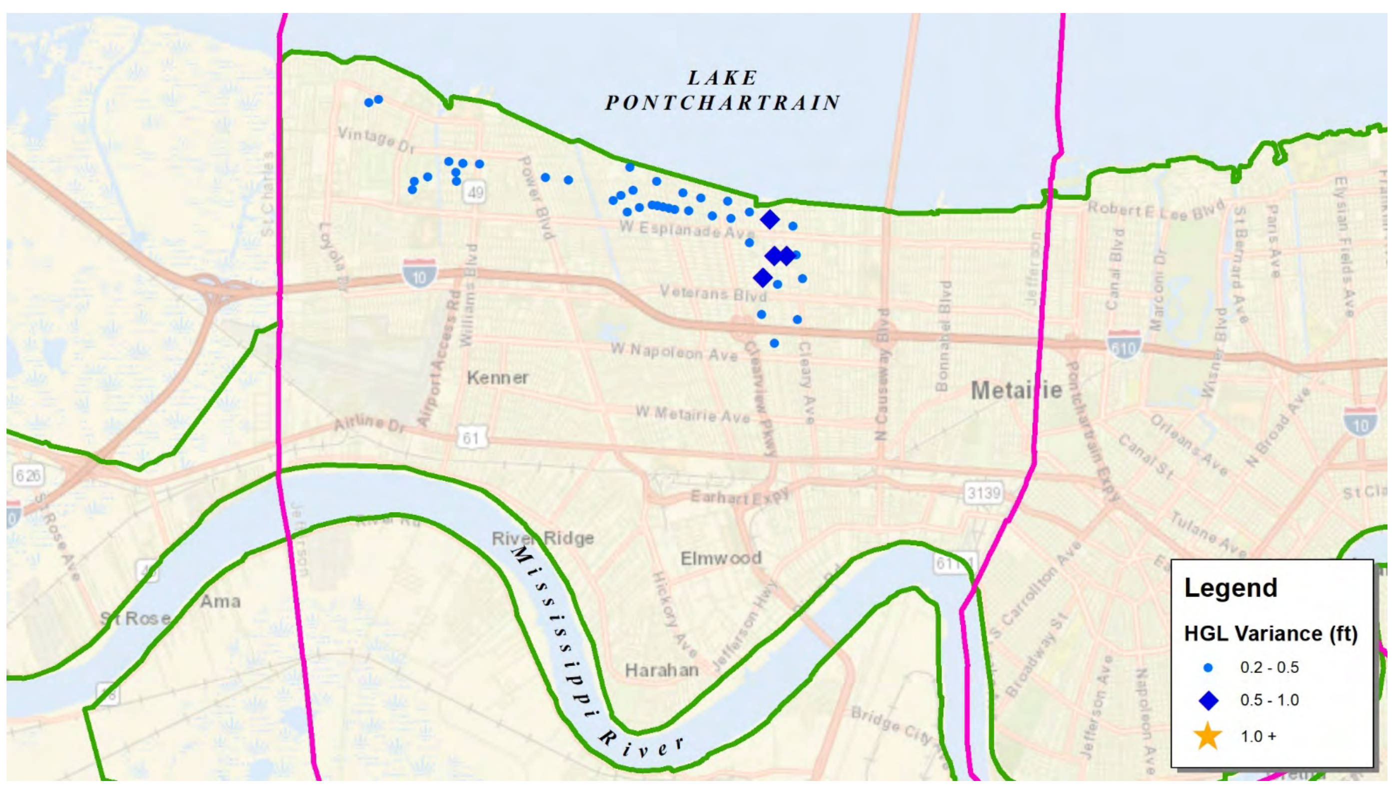

Figure A08: 100-Year TP-40 Storm, 5.9-ft Sea Level Rise

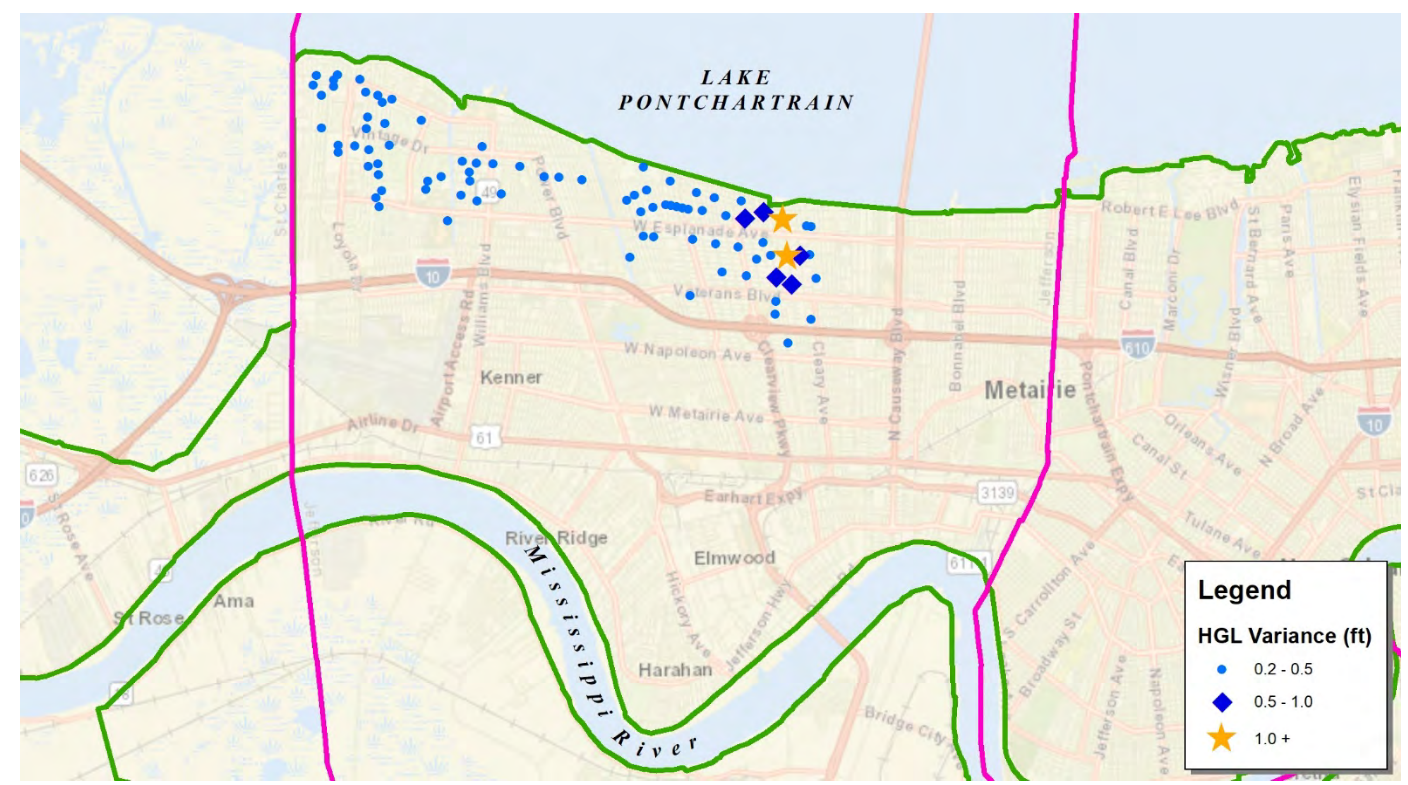

Figure A09: 100-Year TP-40 Storm, 8.07-ft Sea Level Rise

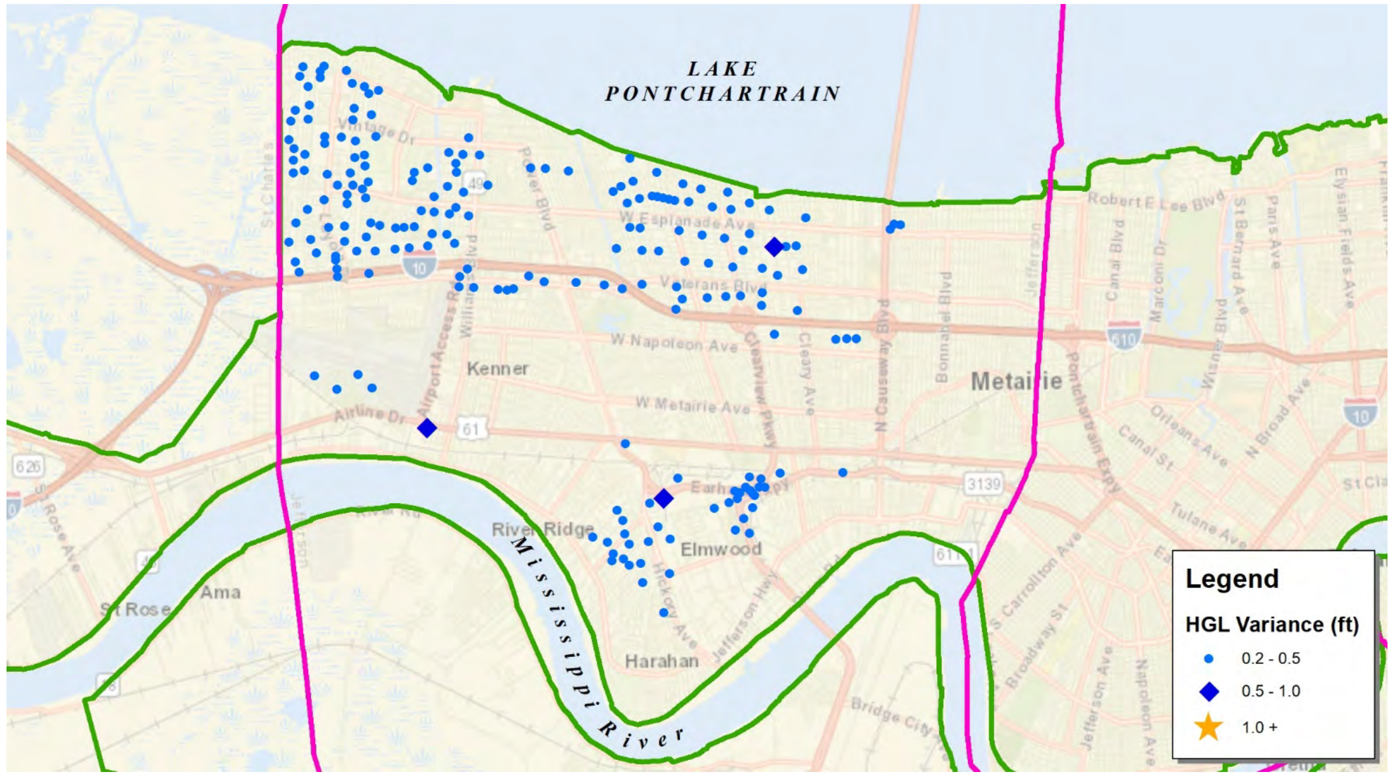

Figure A10: 100-Year Noaa Storm, 0.0-ft Sea Level Rise

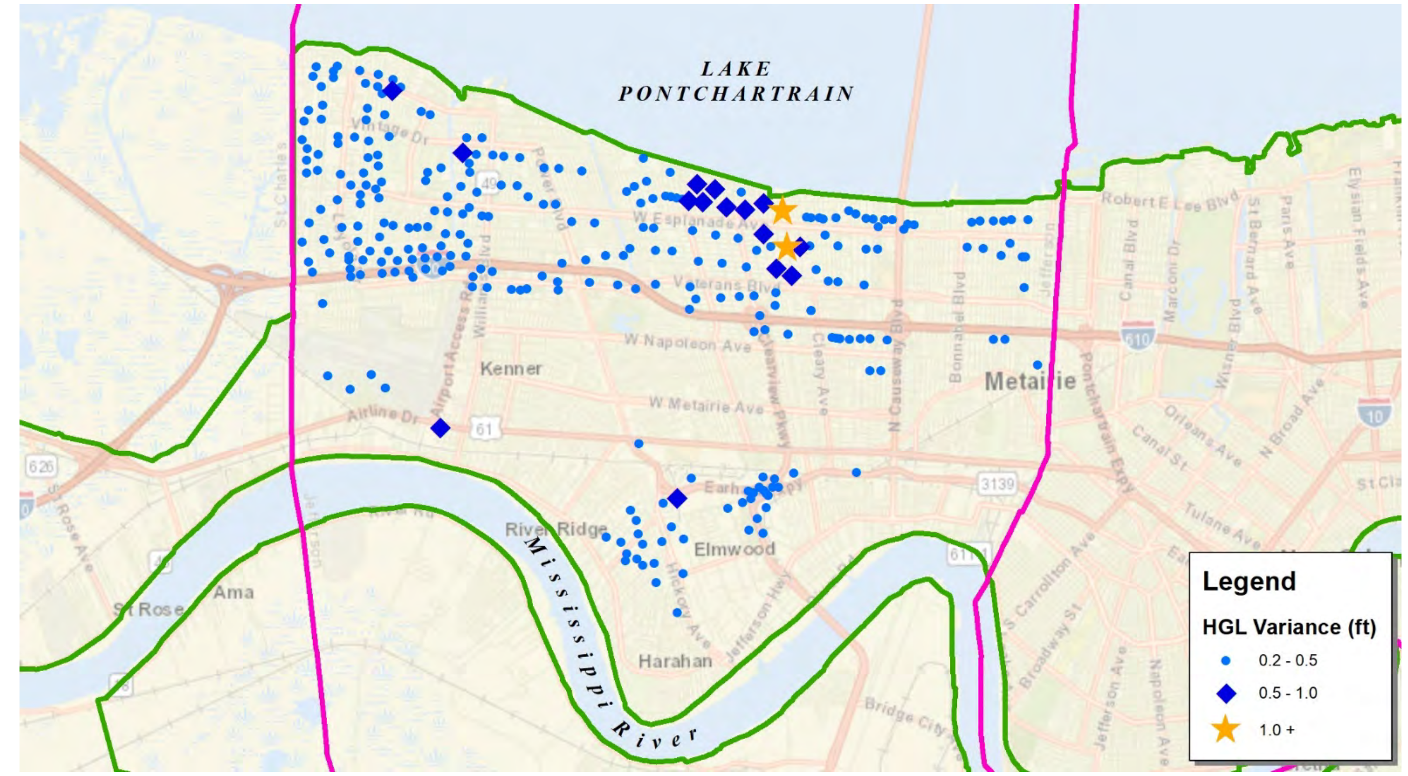

Figure A11: 100-Year Noaa Storm, 4.0-ft Sea Level Rise

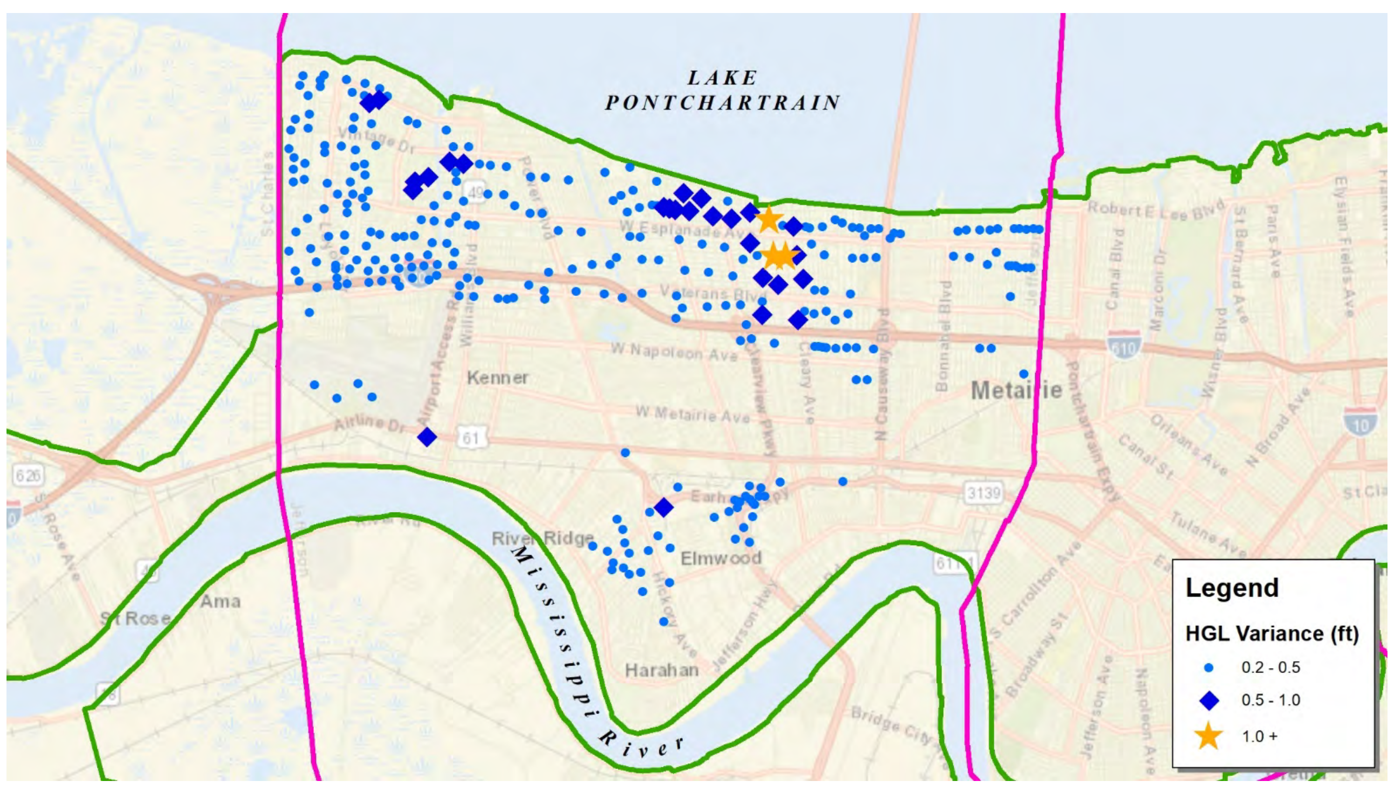

Figure A12: 100-Year Noaa Storm, 5.9-ft Sea Level Rise

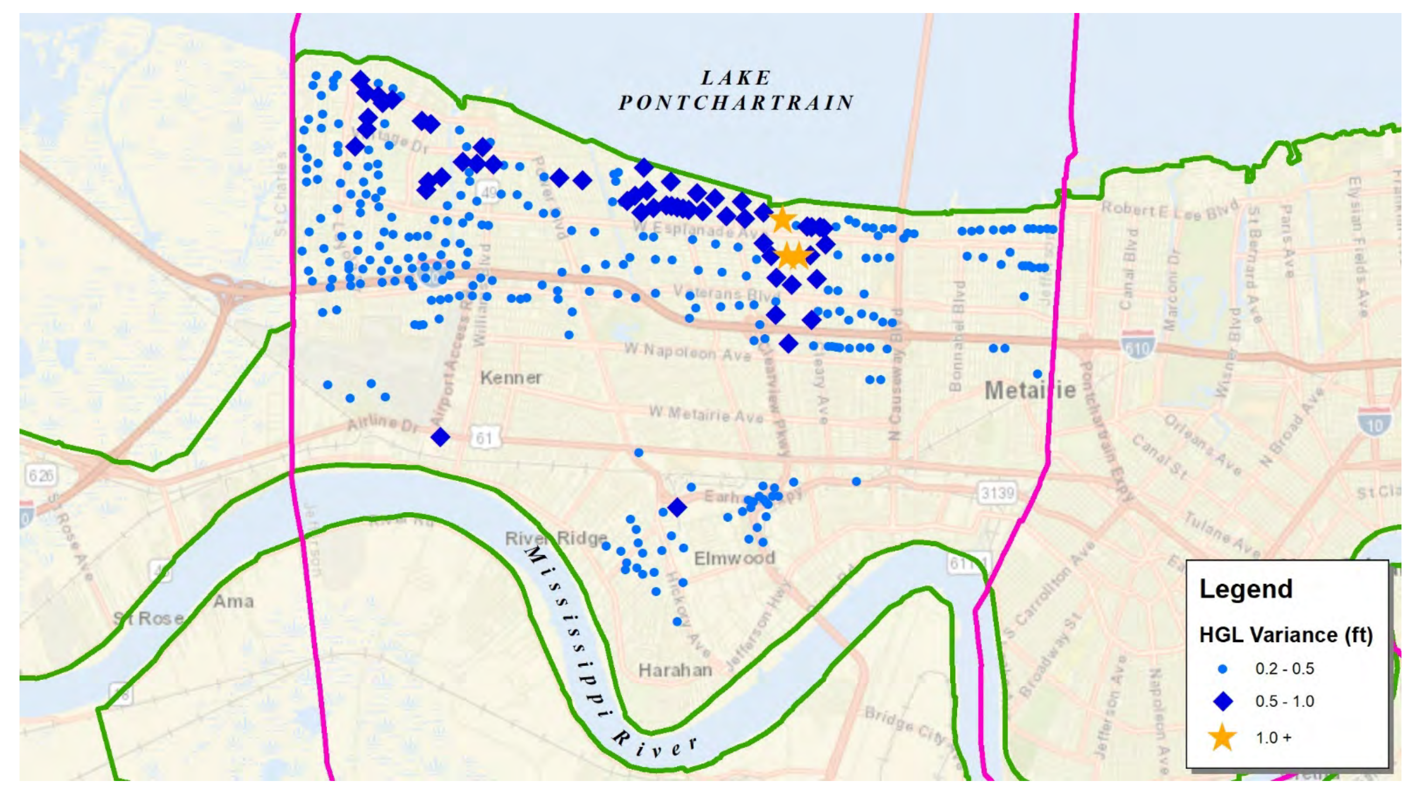

Figure A13: 100-Year Noaa Storm, 8.07-ft Sea Level Rise

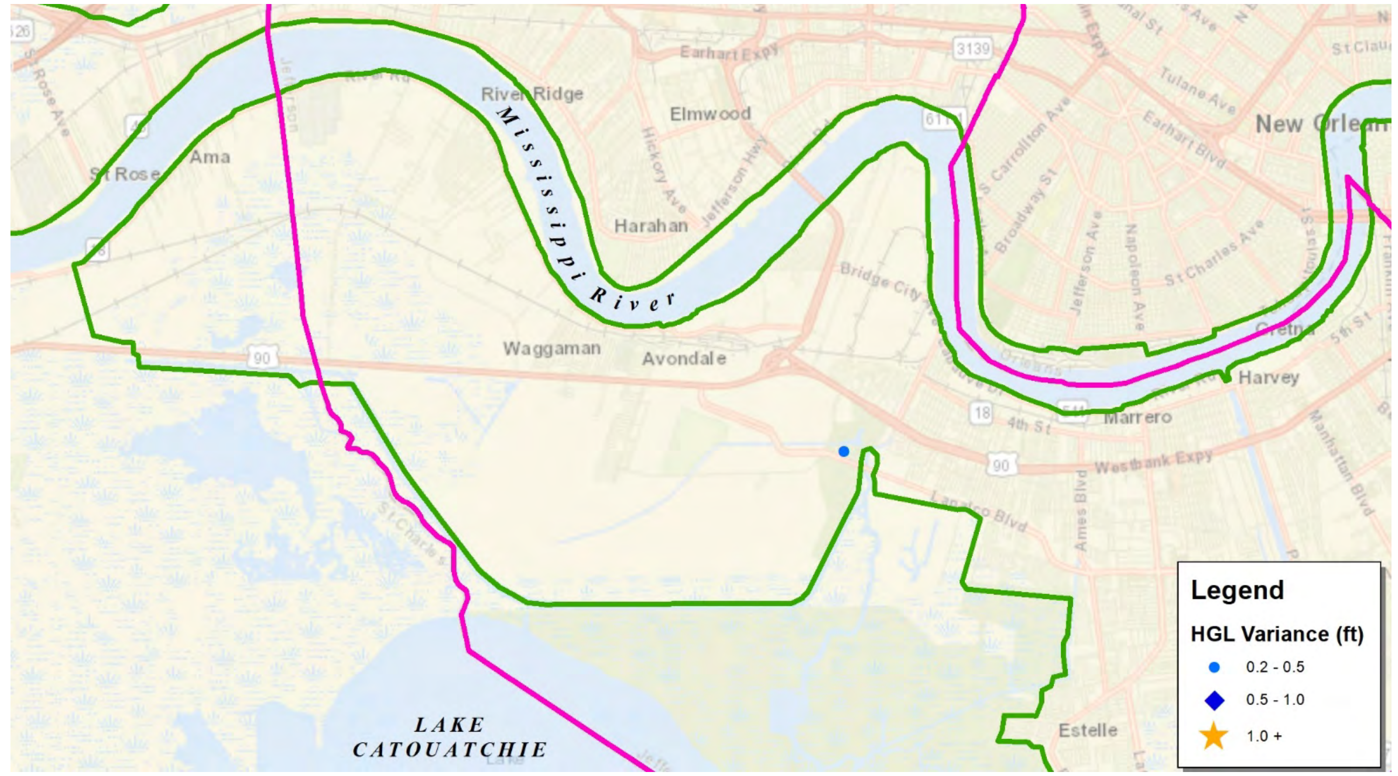

Figure A14: 10-Year TP-40 Storm, 4.0-ft Sea Level Rise

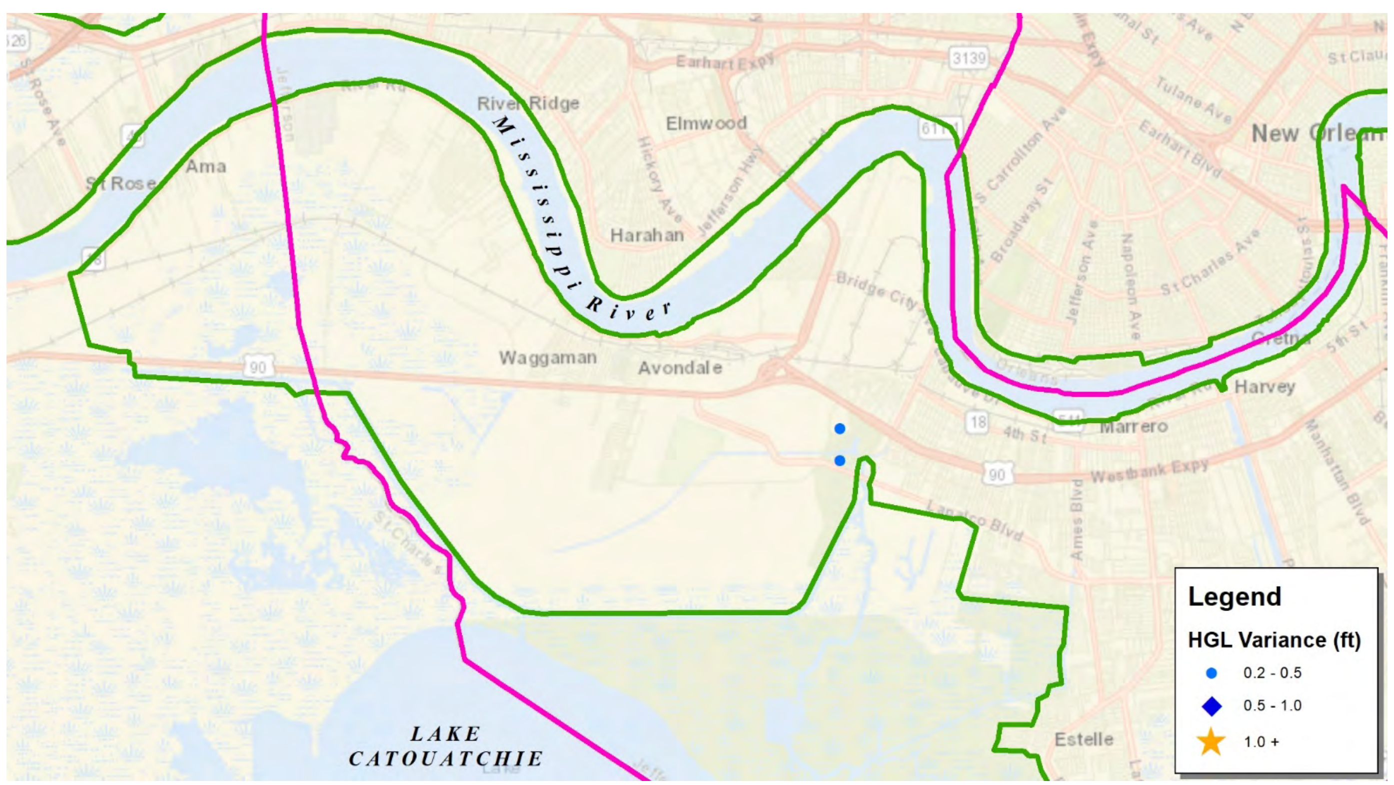

Figure A15: 10-Year TP-40 Storm, 5.9-ft Sea Level Rise

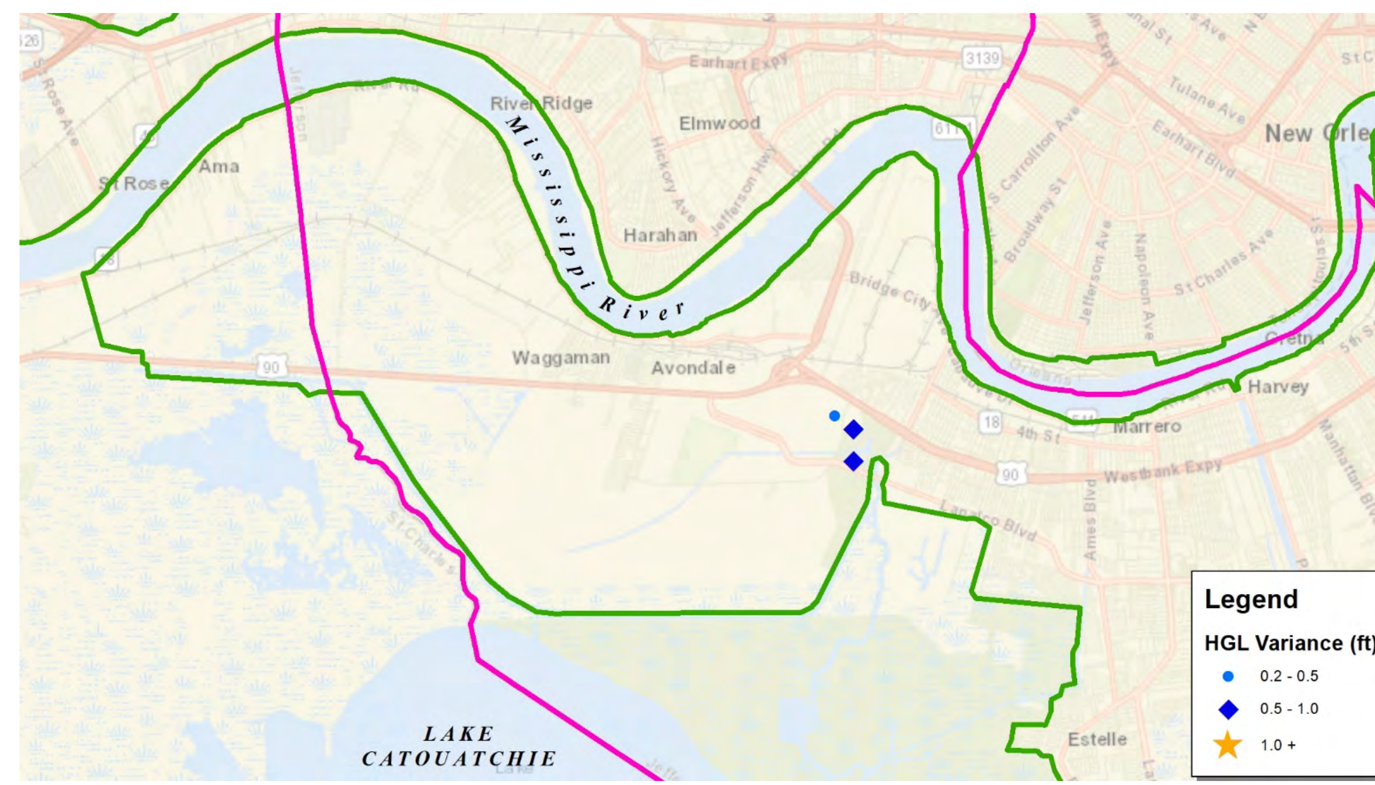

Figure A16: 10-Year TP-40 Storm, 8.07-ft Sea Level Rise

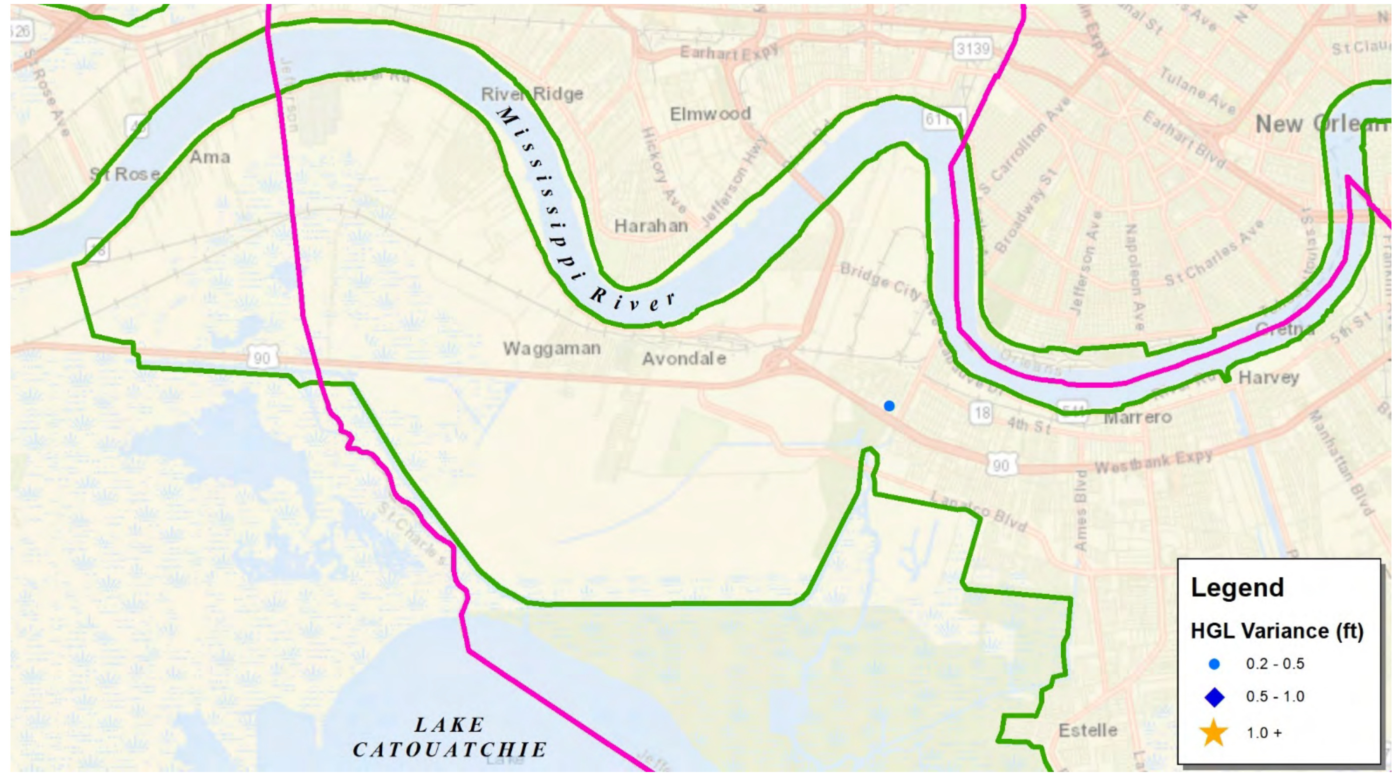

Figure A17: 25-Year TP-40 Storm, 4.0-ft Sea Level Rise

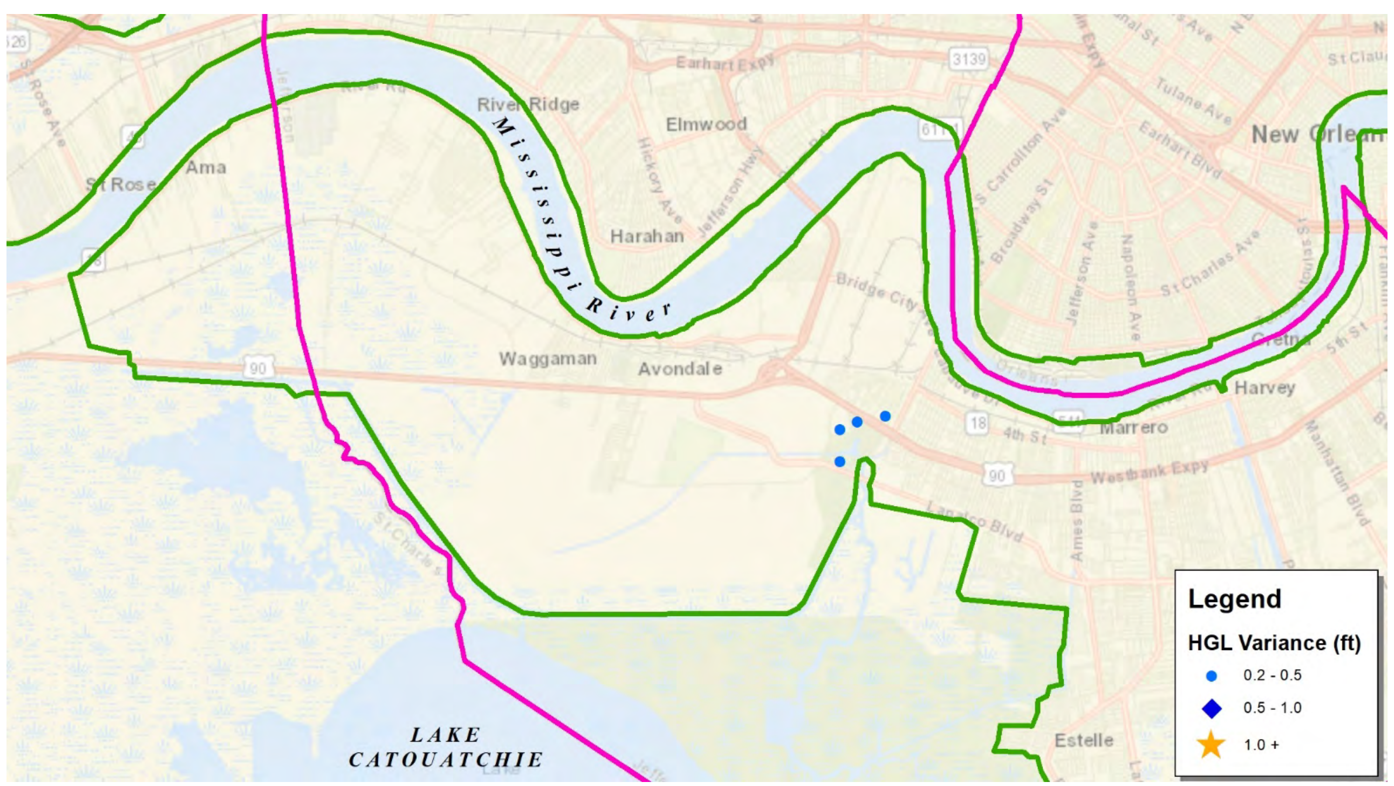

Figure A18: 25-Year TP-40 Storm, 5.9-ft Sea Level Rise

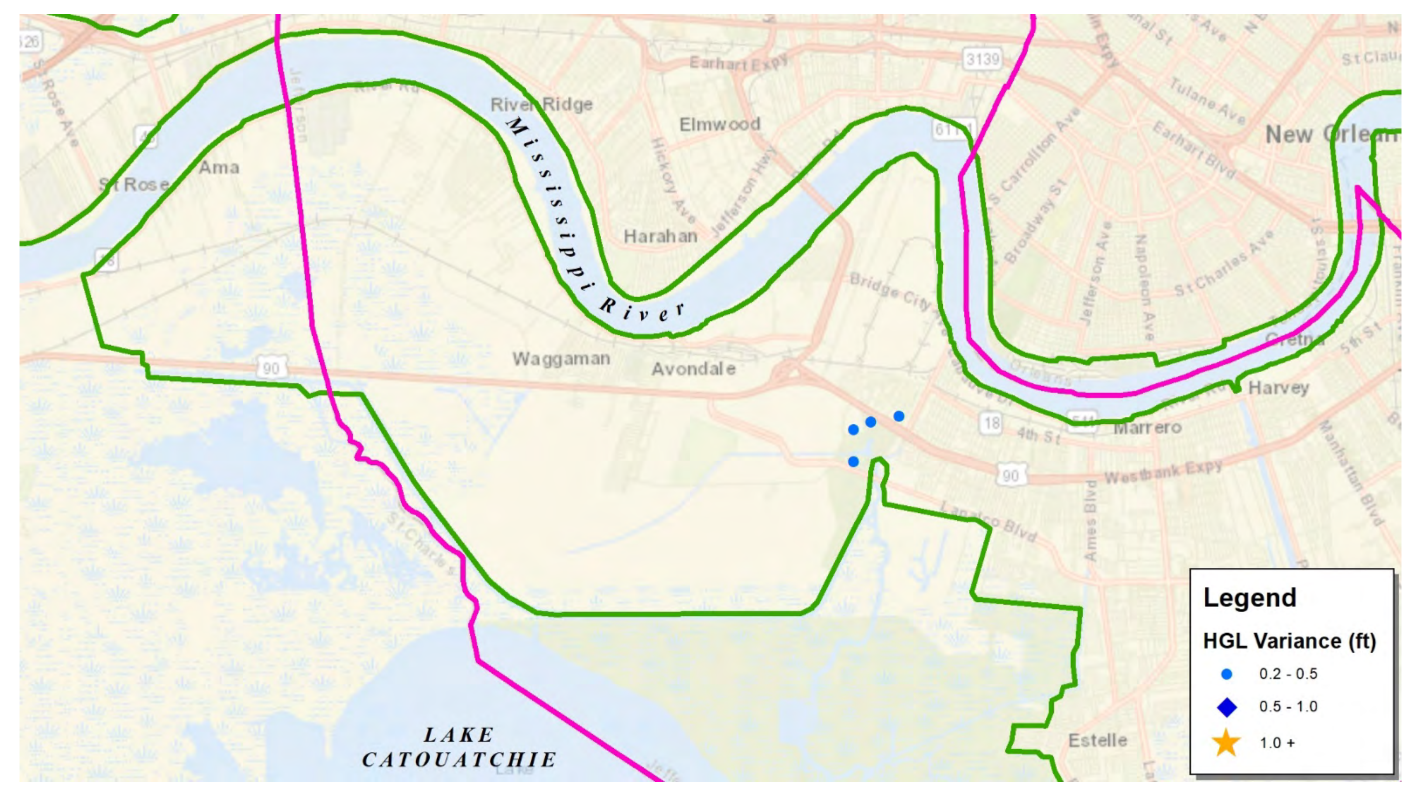

Figure A19: 25-Year TP-40 Storm, 8.07-ft Sea Level Rise

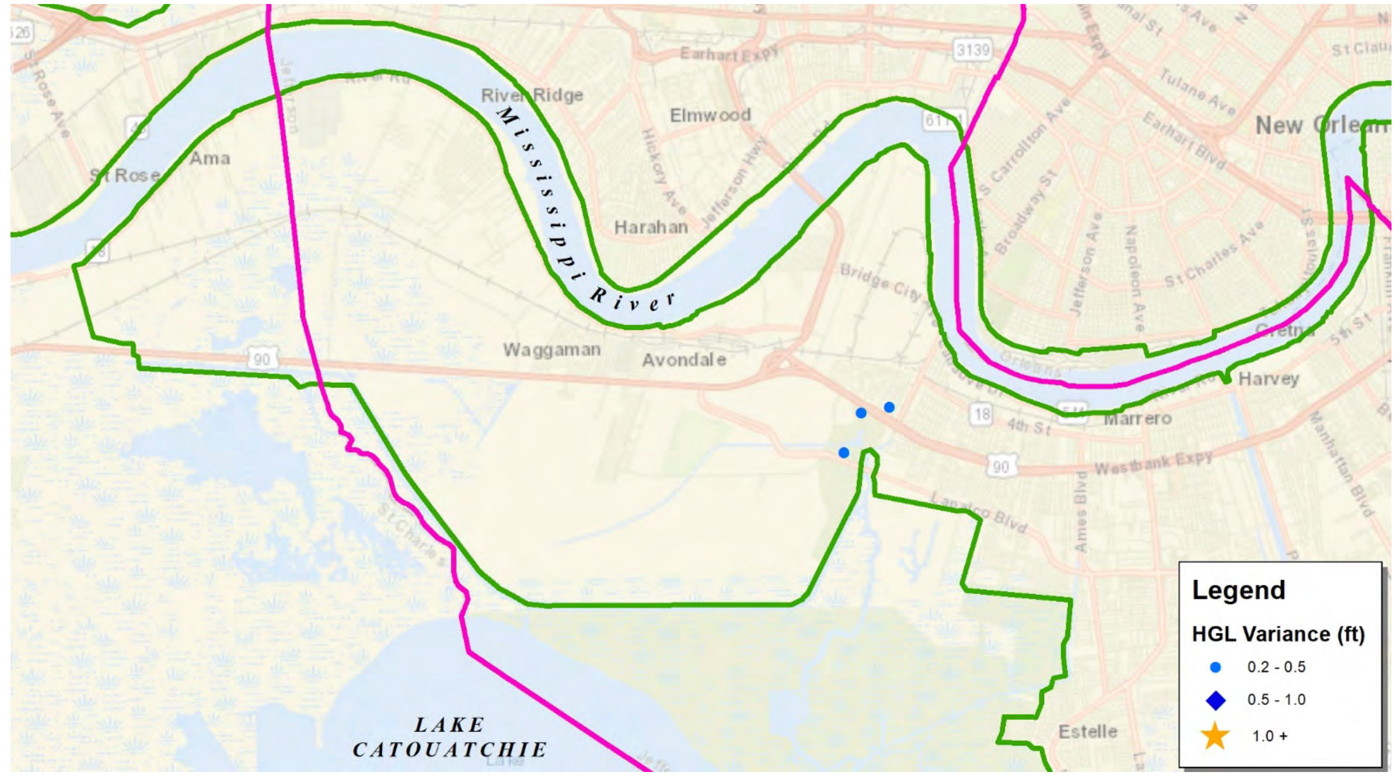

Figure A20: 100-Year TP-40 Storm, 4.0-ft Sea Level Rise

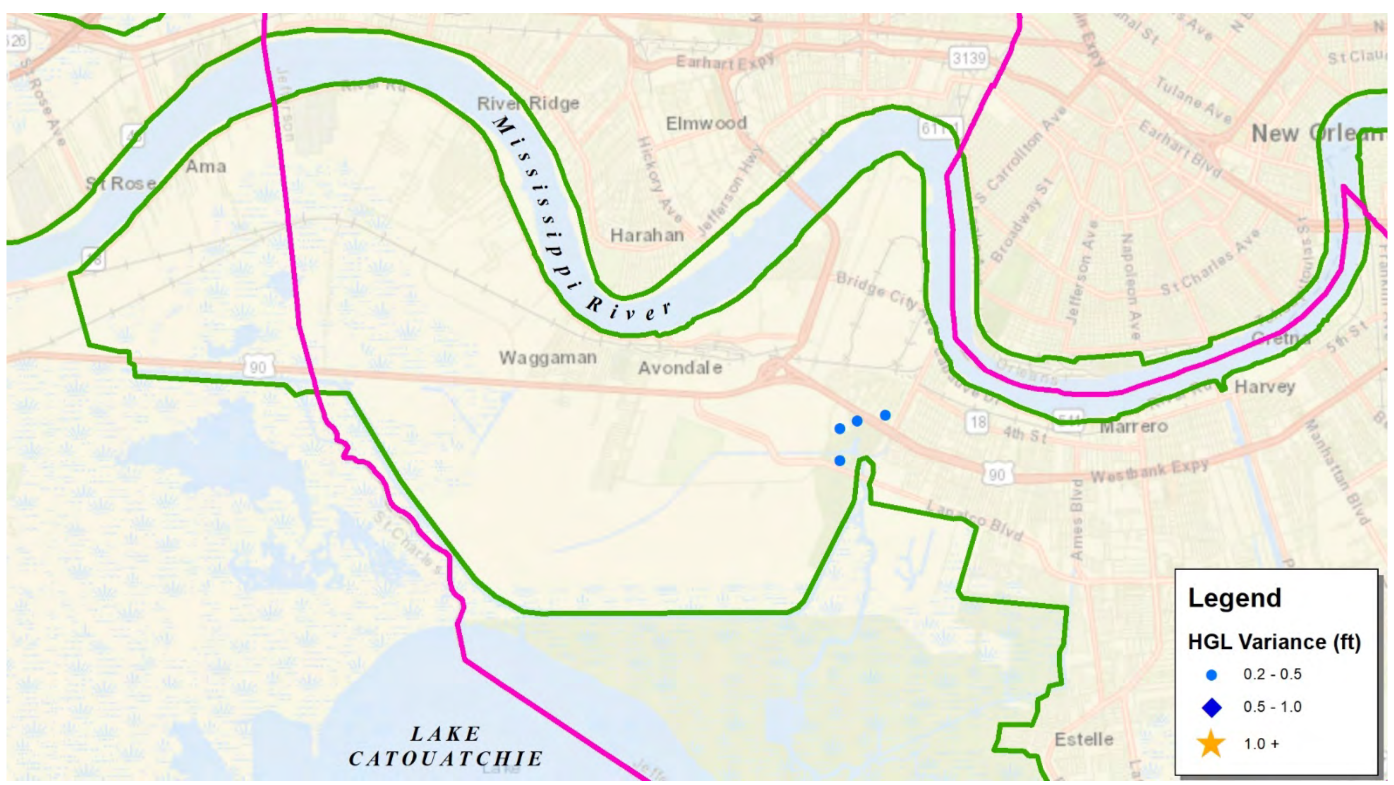

Figure A21: 100-Year TP-40 Storm, 5.9-ft Sea Level Rise

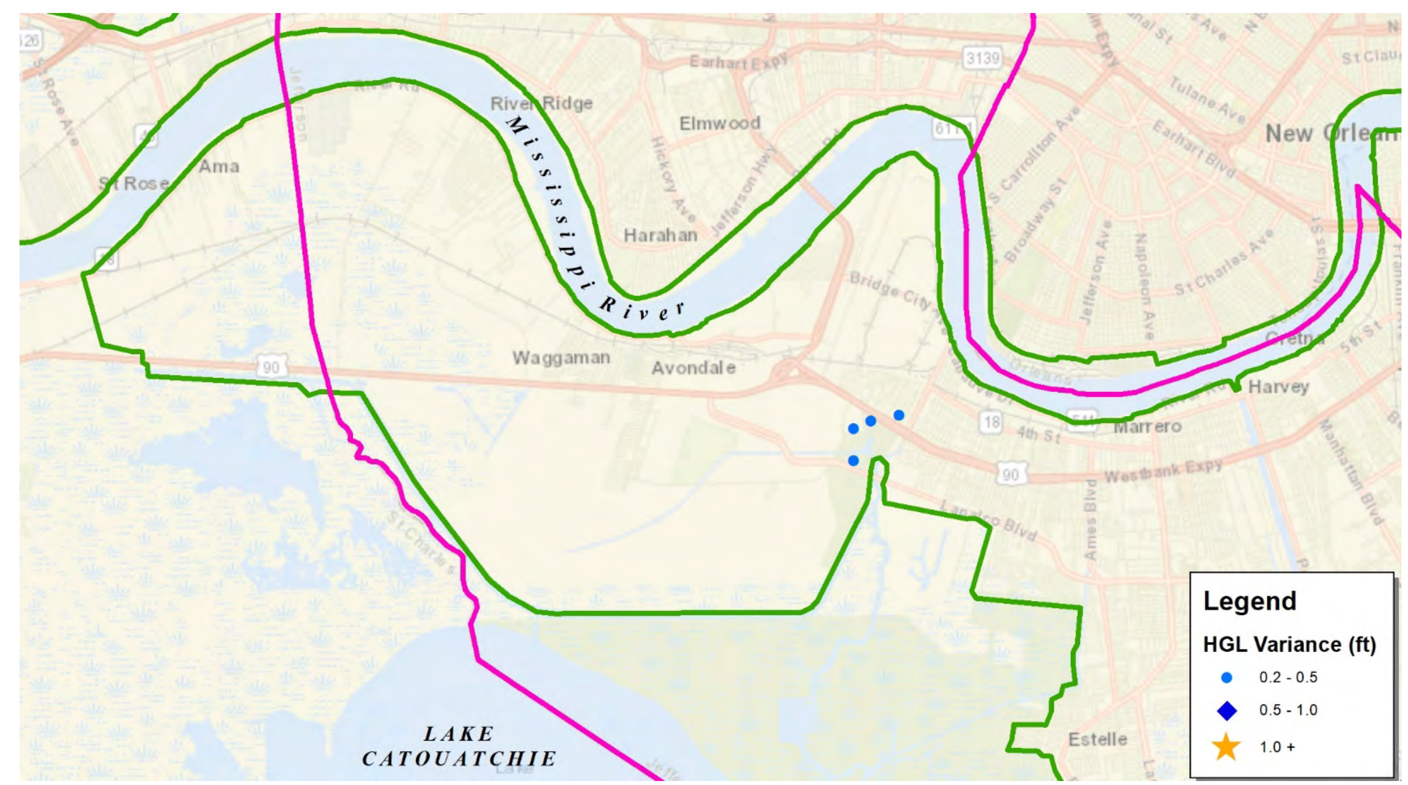

Figure A22: 100-Year TP-40 Storm, 8.07-ft Sea Level Rise

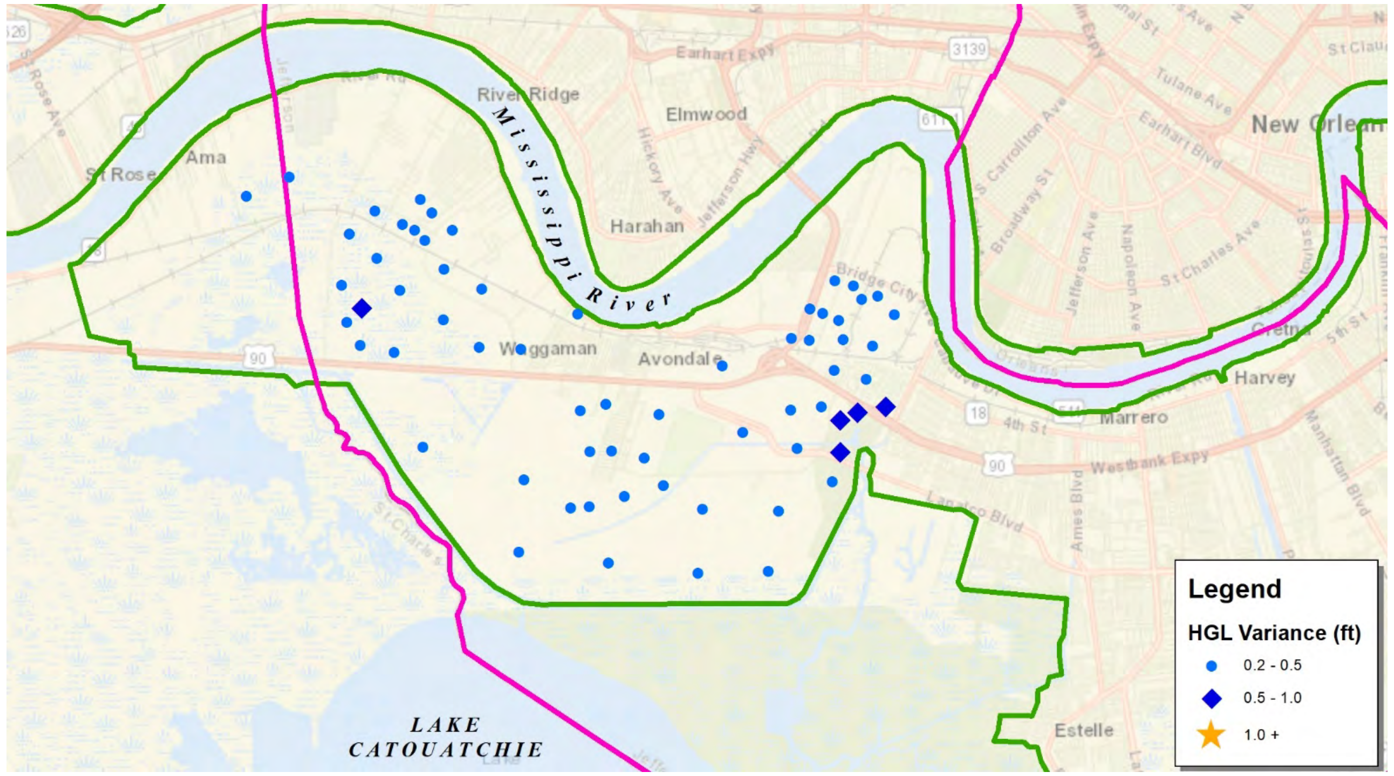

Figure A23: 100-Year Noaa Storm, 0.0-ft Sea Level Rise

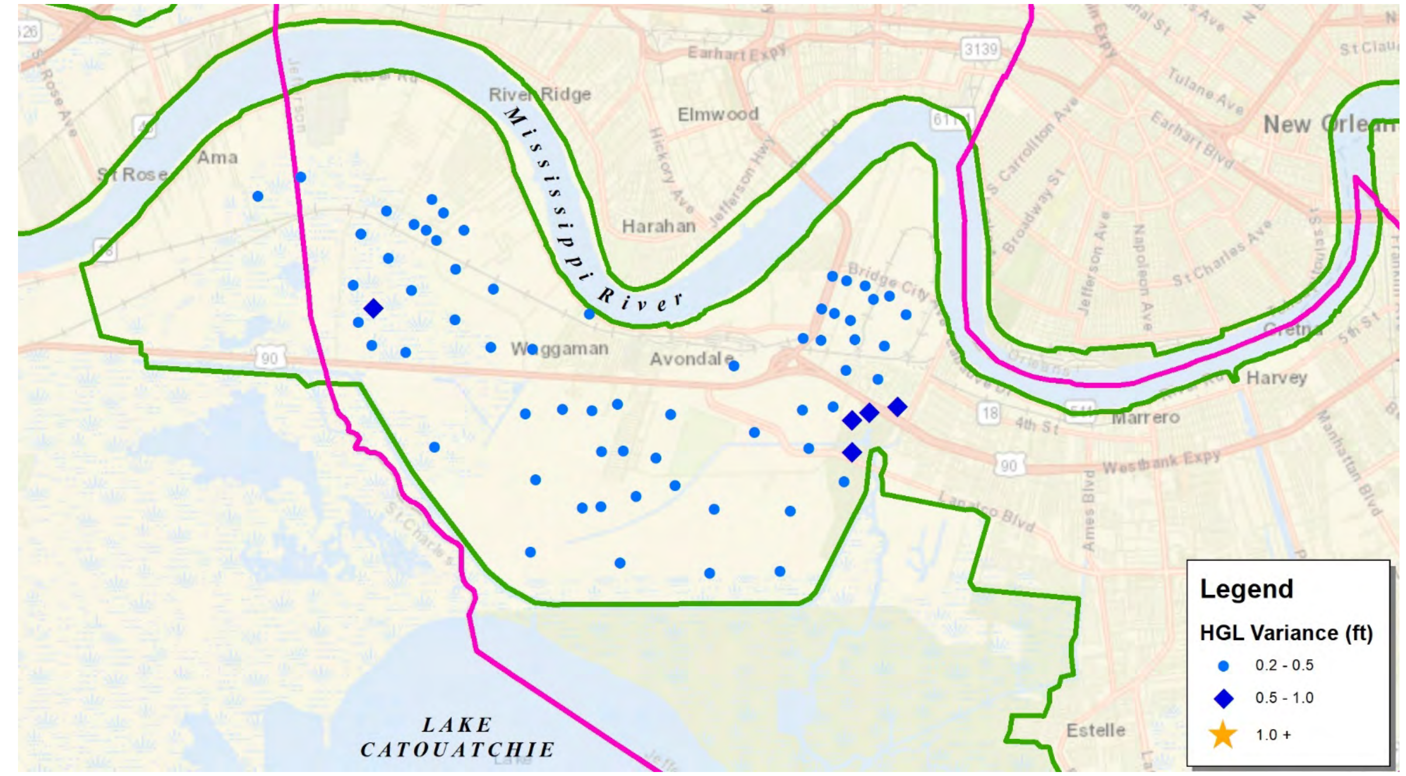

Figure A24: 100-Year Noaa Storm, 4.0-ft Sea Level Rise

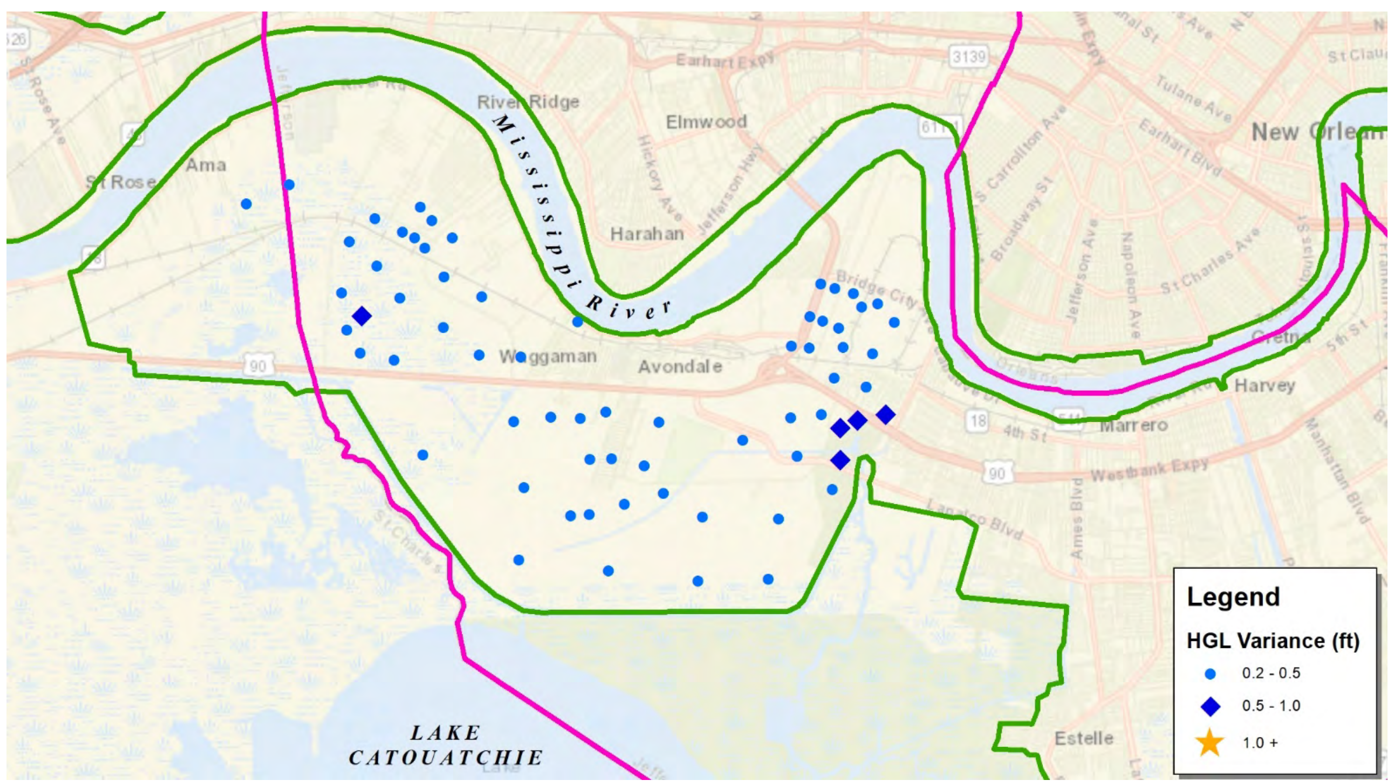

Figure A25: 100-Year Noaa Storm, 5.9-ft Sea Level Rise

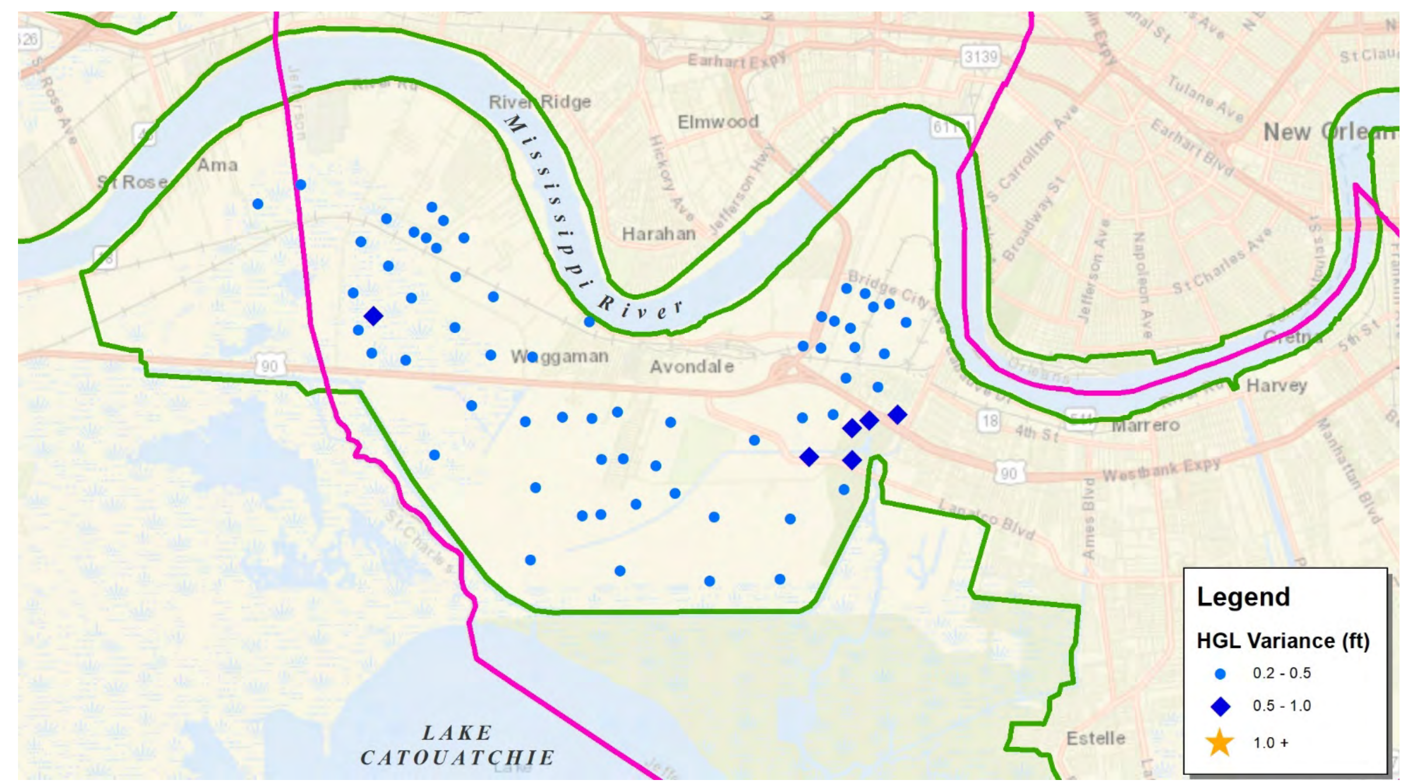

Figure A26: 100-Year Noaa Storm, 8.07-ft Sea Level Rise

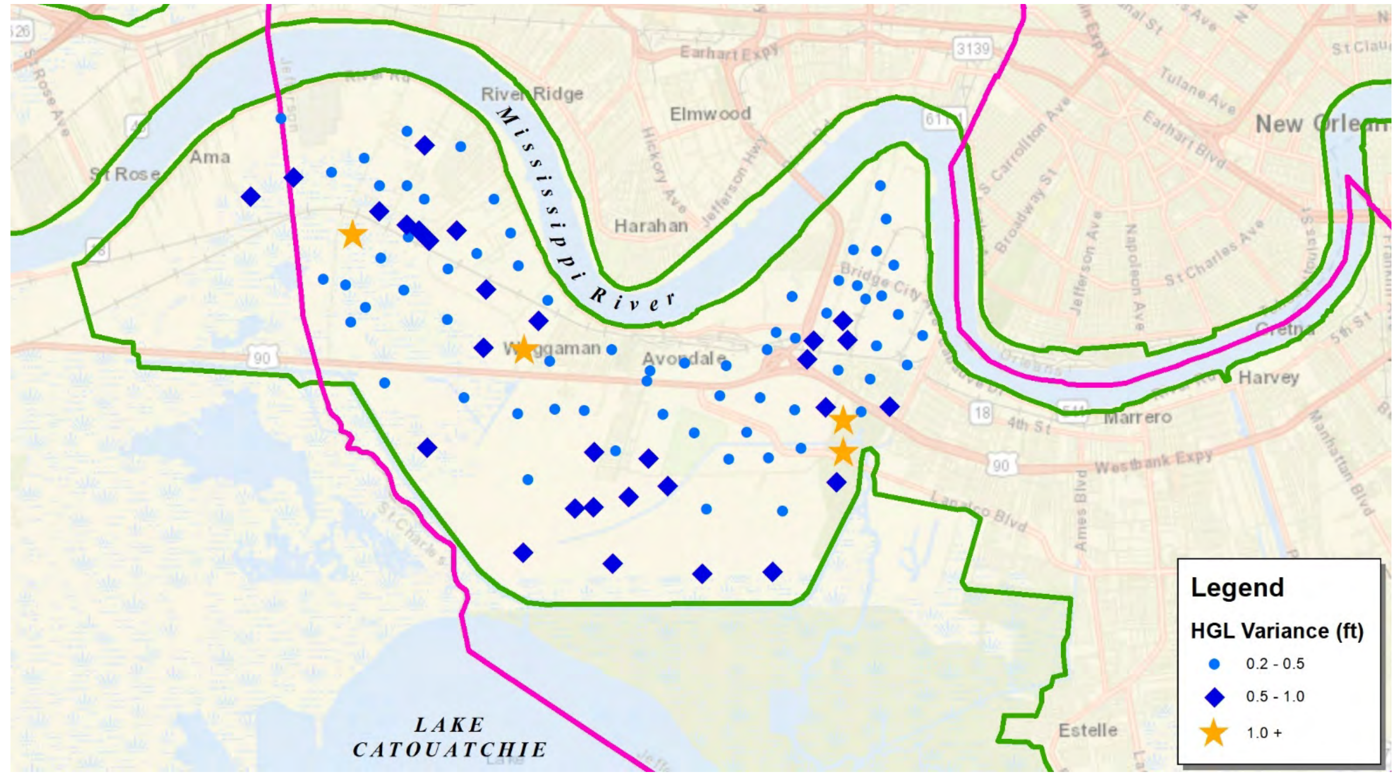

Figure A27: 10-Year, TP-40 Storm, 0.0-ft Sea Level Rise, Future Development

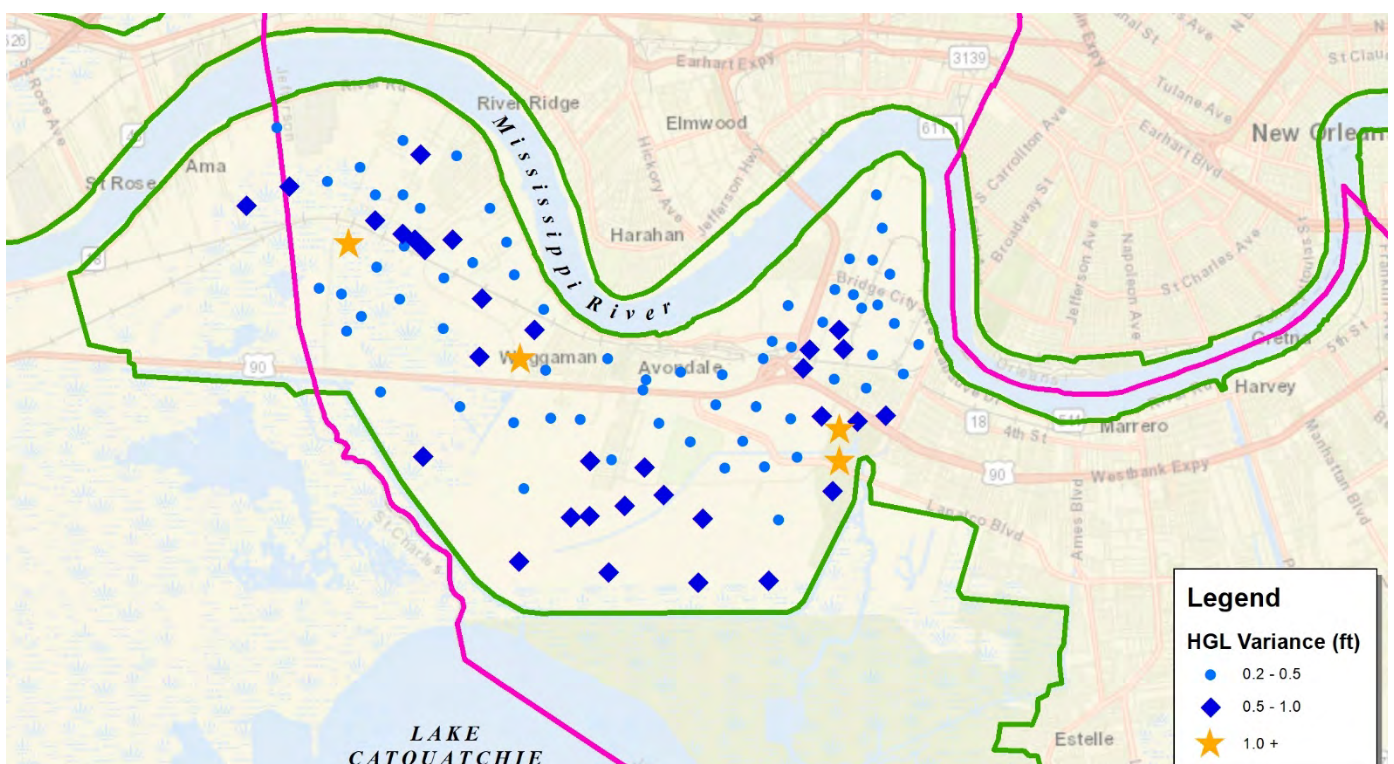

Figure A28: 10-Year, TP-40 Storm, 5.9-ft Sea Level Rise, Future Development

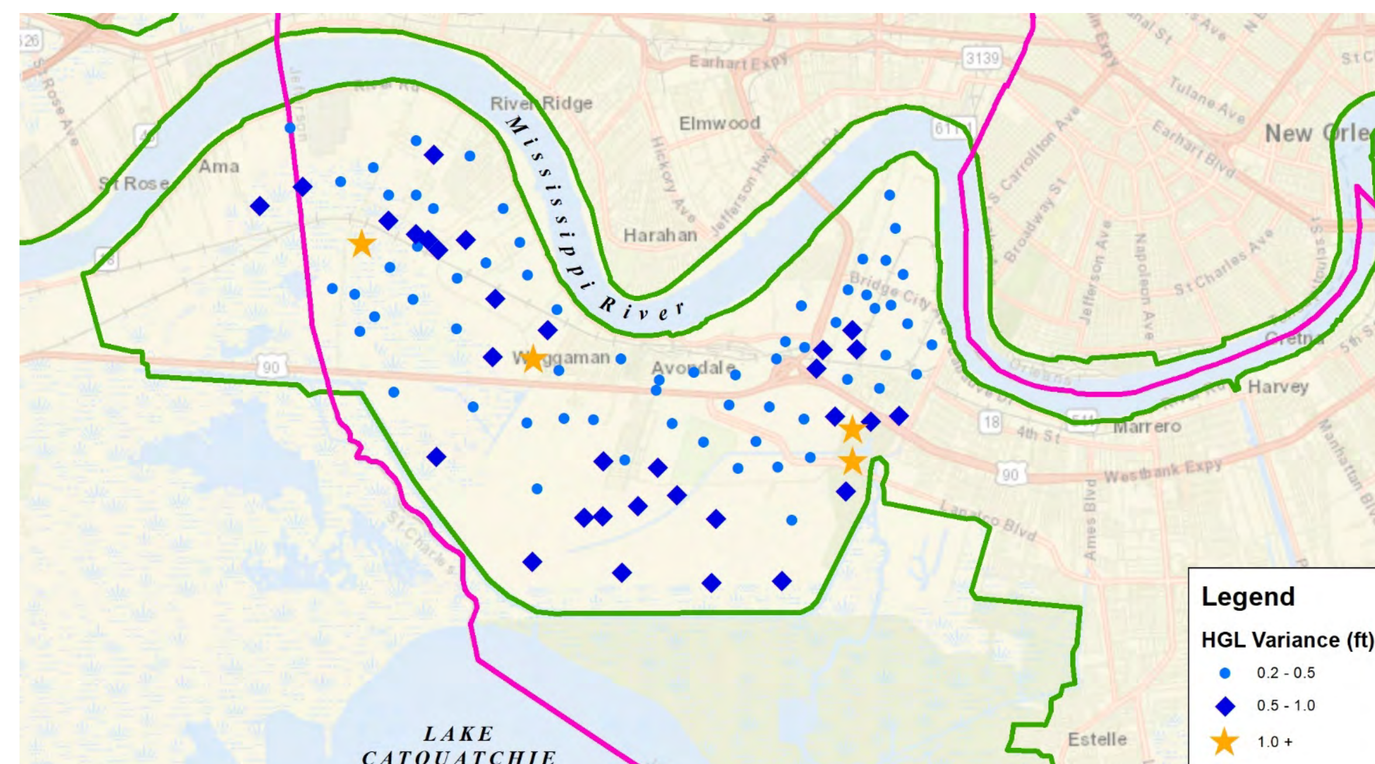

Figure A29: 10-Year, TP-40 Storm, 8.07-ft Sea Level Rise, Future Development

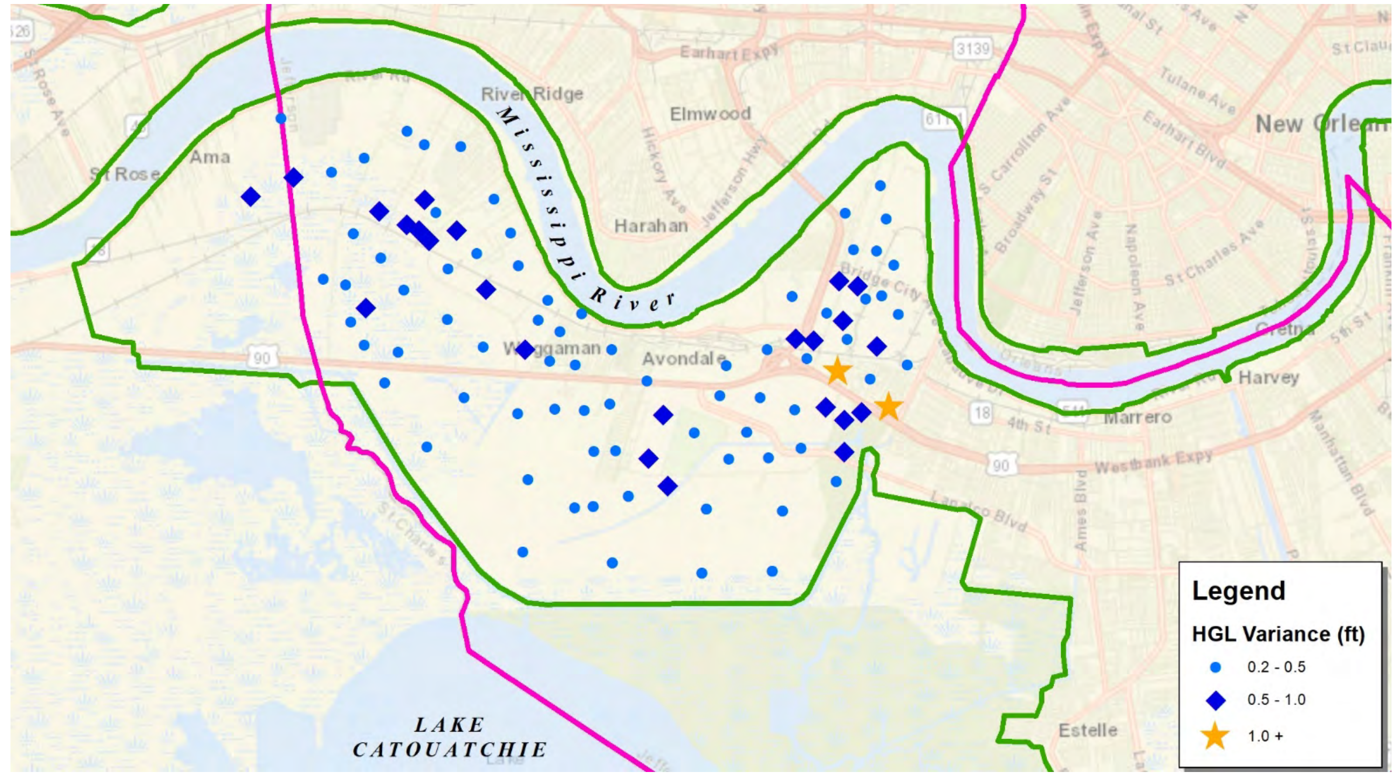

Figure A30: 25-Year, TP-40 Storm, 0.0-ft Sea Level Rise, Future Development

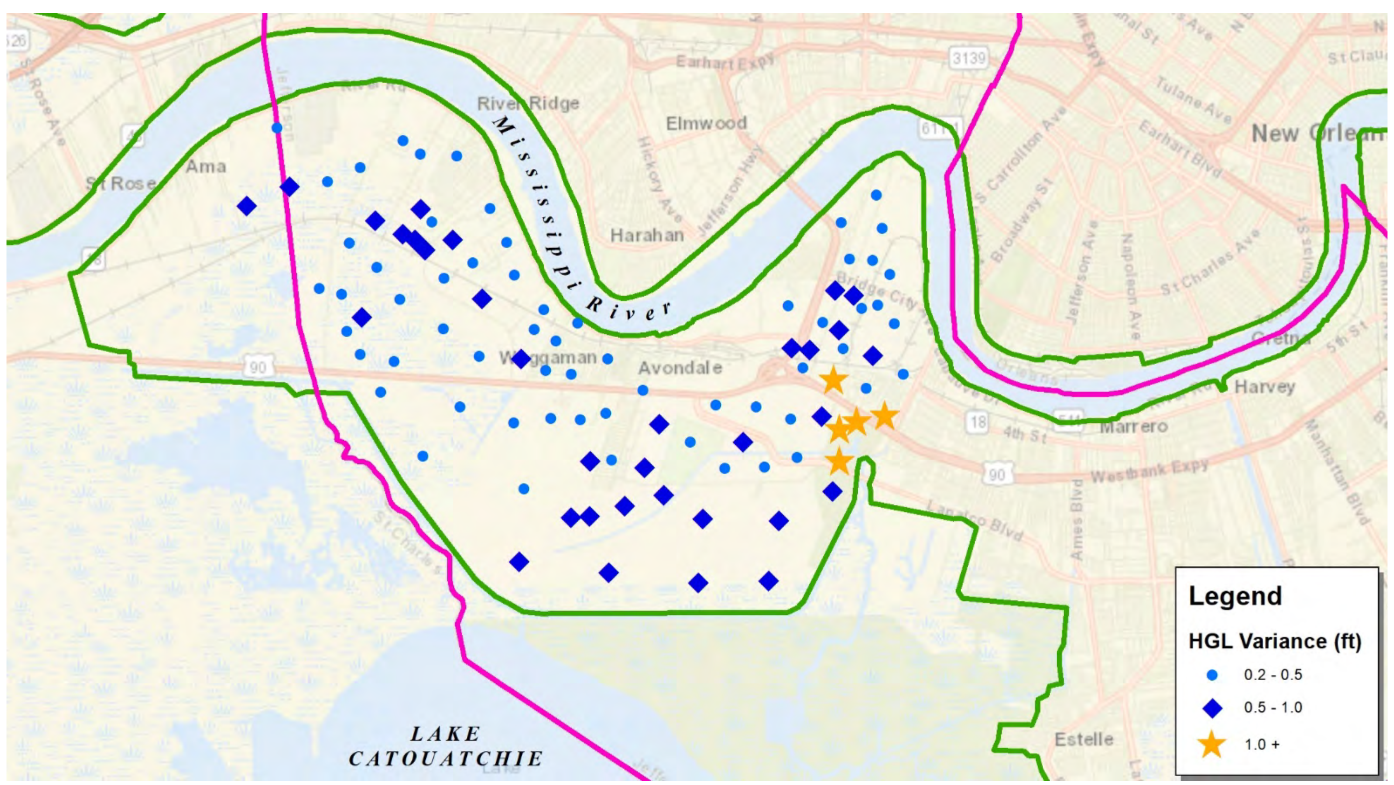

Figure A31: 25-Year, TP-40 Storm, 5.9-ft Sea Level Rise, Future Development

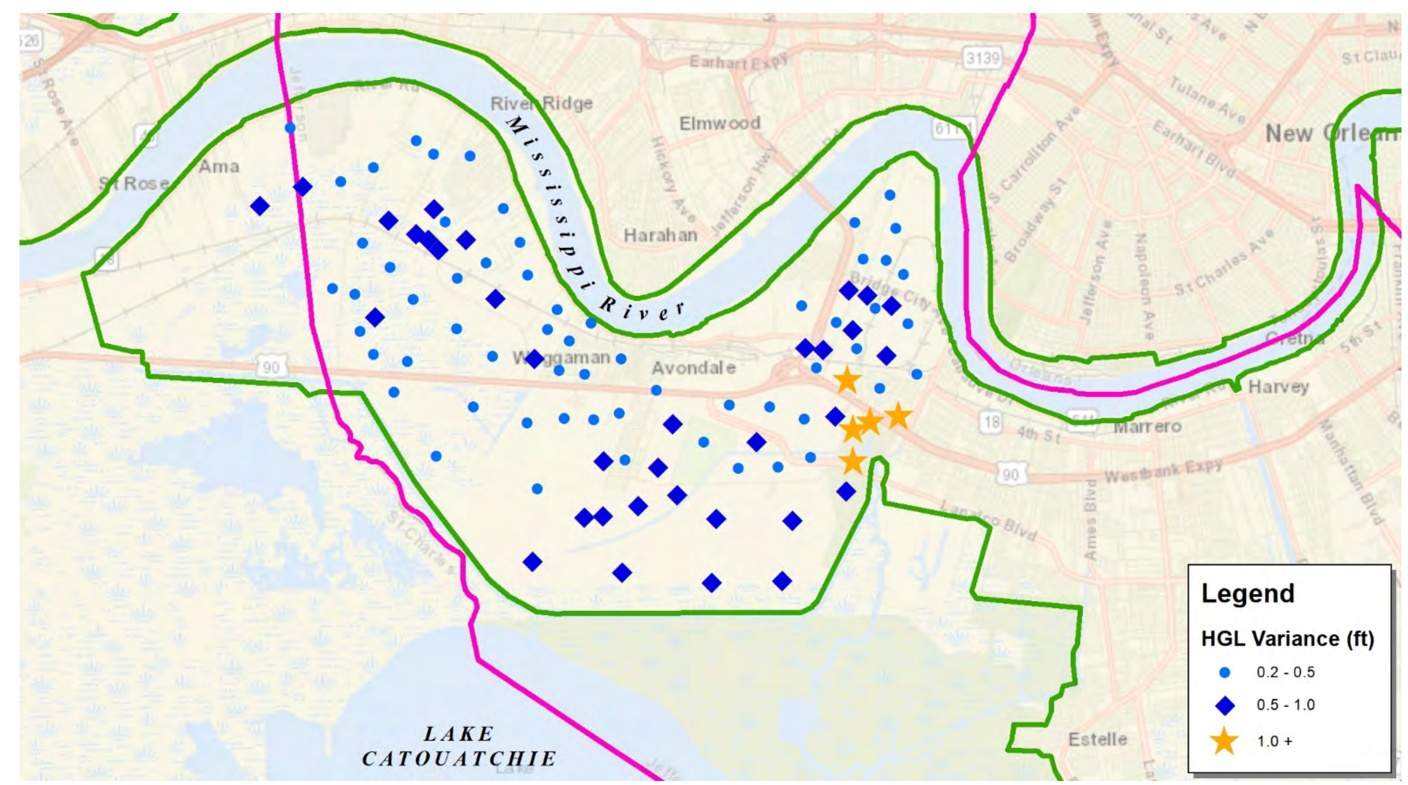

Figure A32: 25-Year, TP-40 Storm, 8.07-ft Sea Level Rise, Future Development

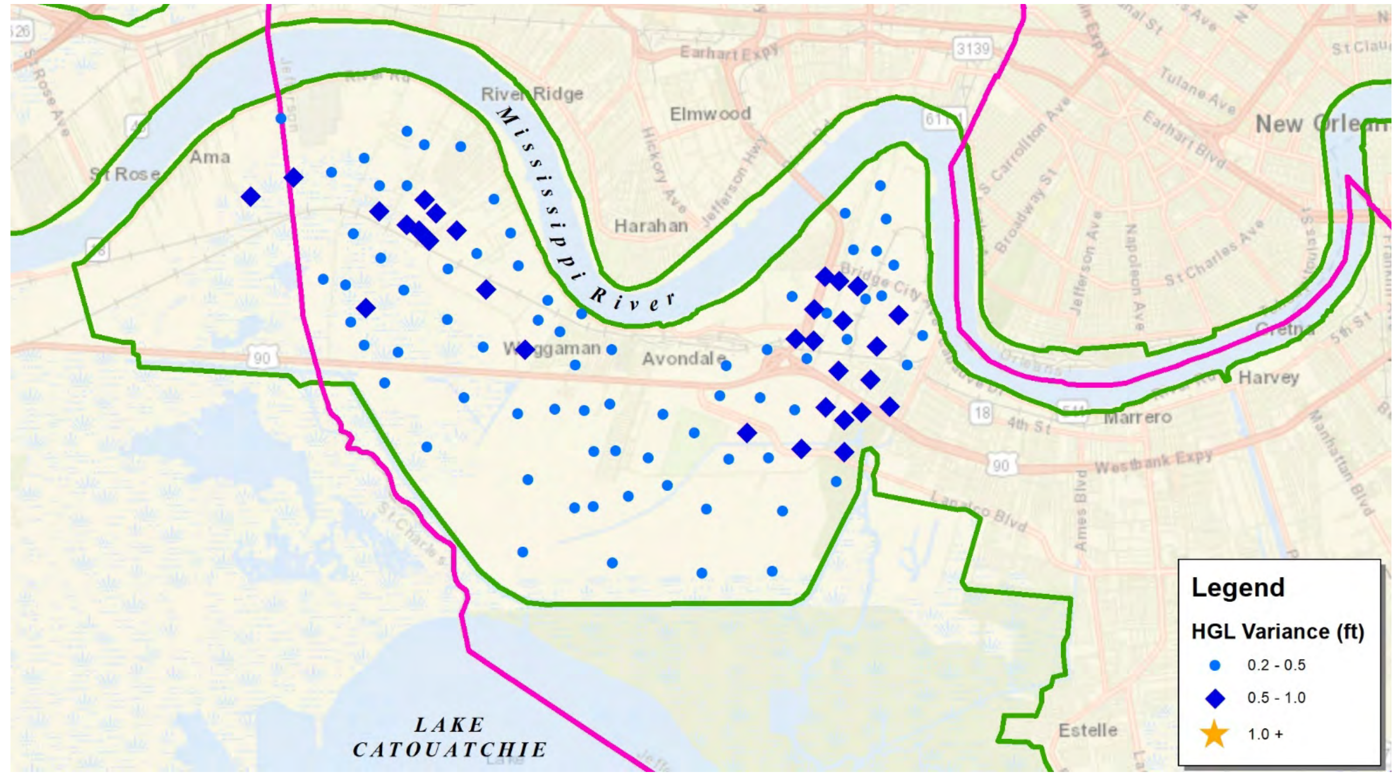

Figure A33: 100-Year, TP-40 Storm, 0.0-ft Sea Level Rise, Future Development

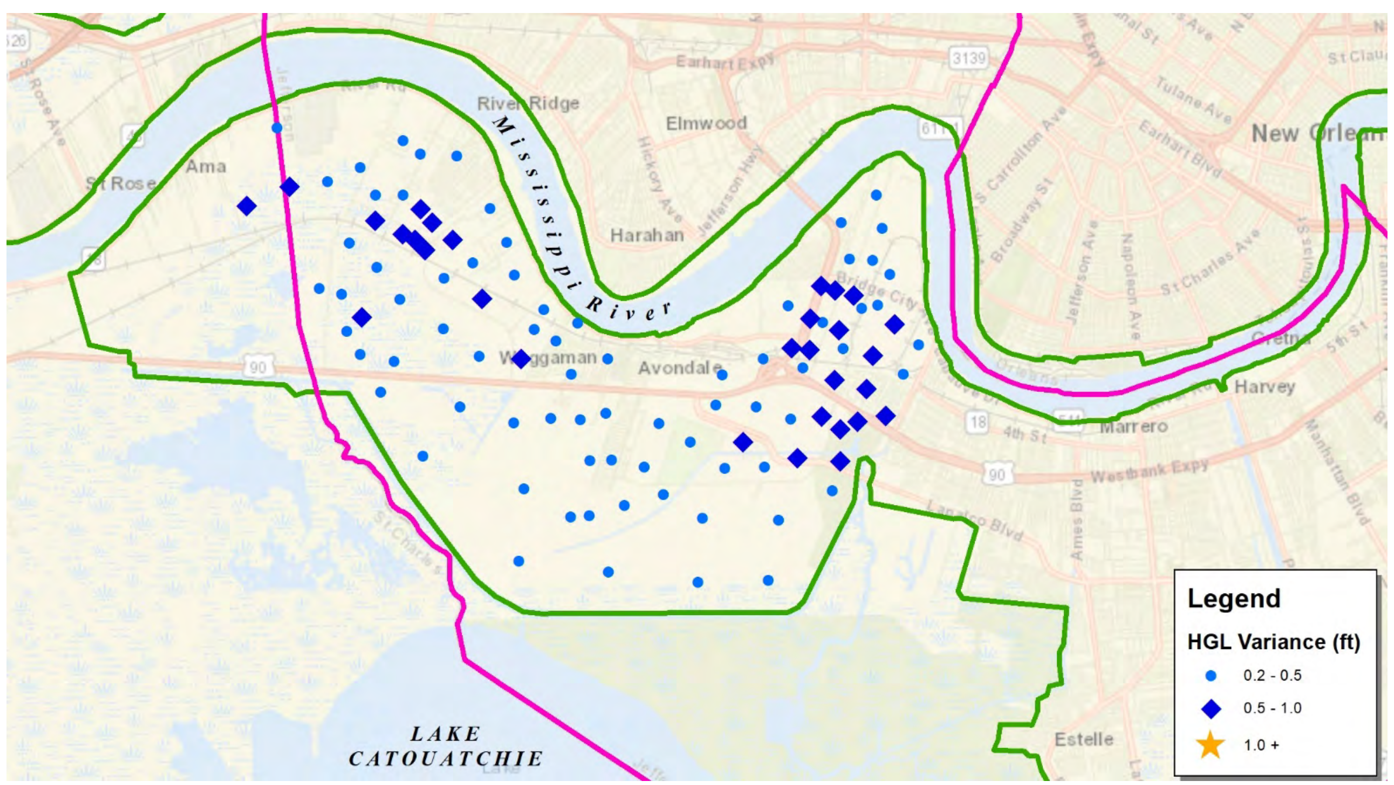

Figure A34: 100-Year, TP-40 Storm, 5.9-ft Sea Level Rise, Future Development

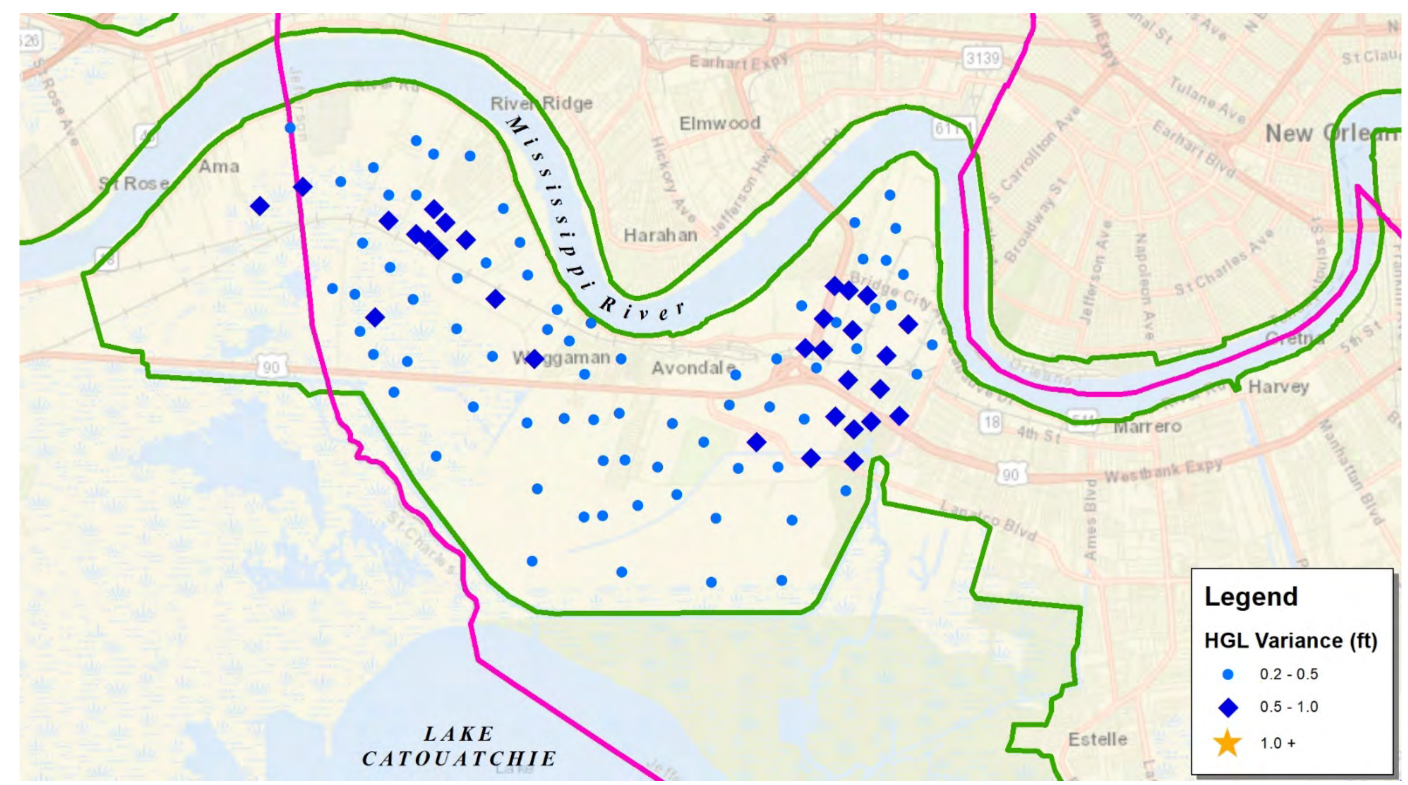

Figure A35: 100-Year, TP-40 Storm, 5.9-ft Sea Level Rise, Future Development

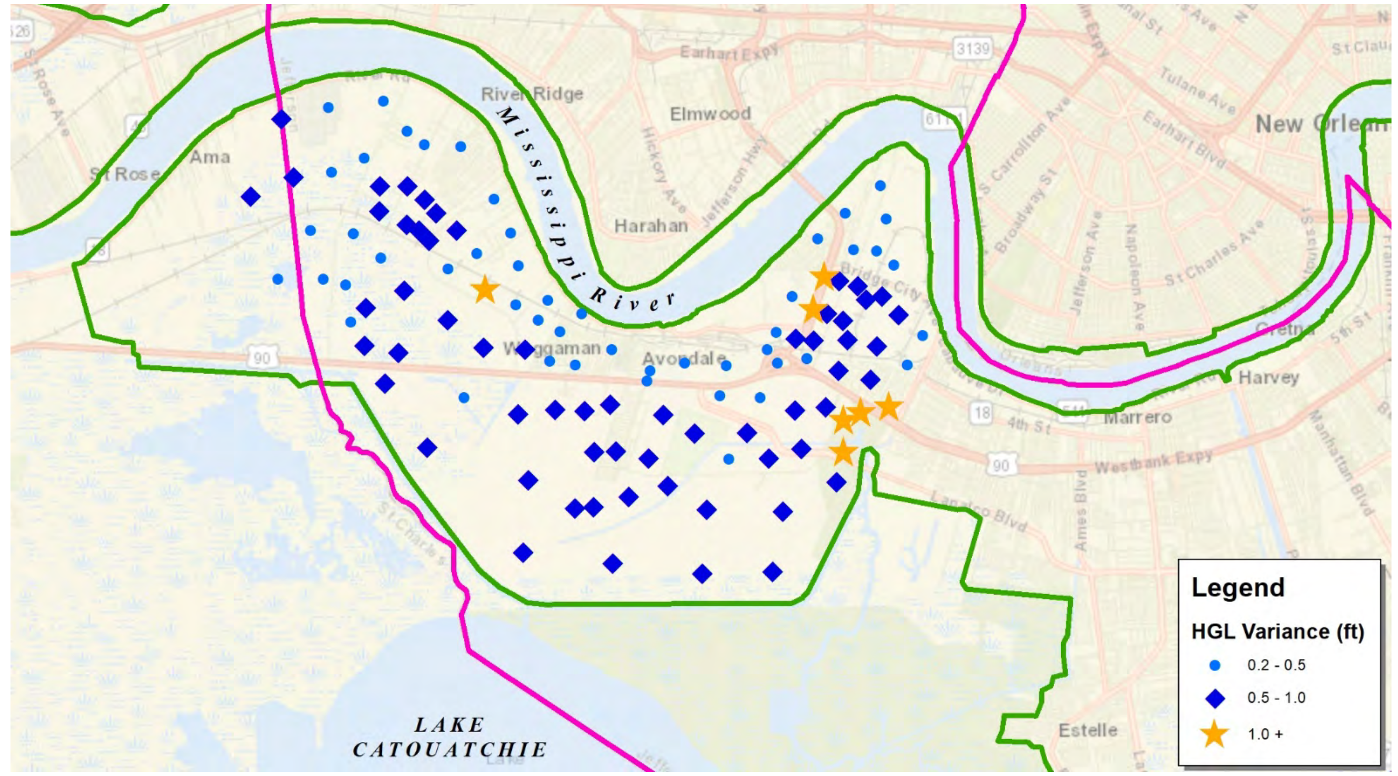

Figure A36: 100-Year, Noaa Storm, 0.0-ft Sea Level Rise, Future Development

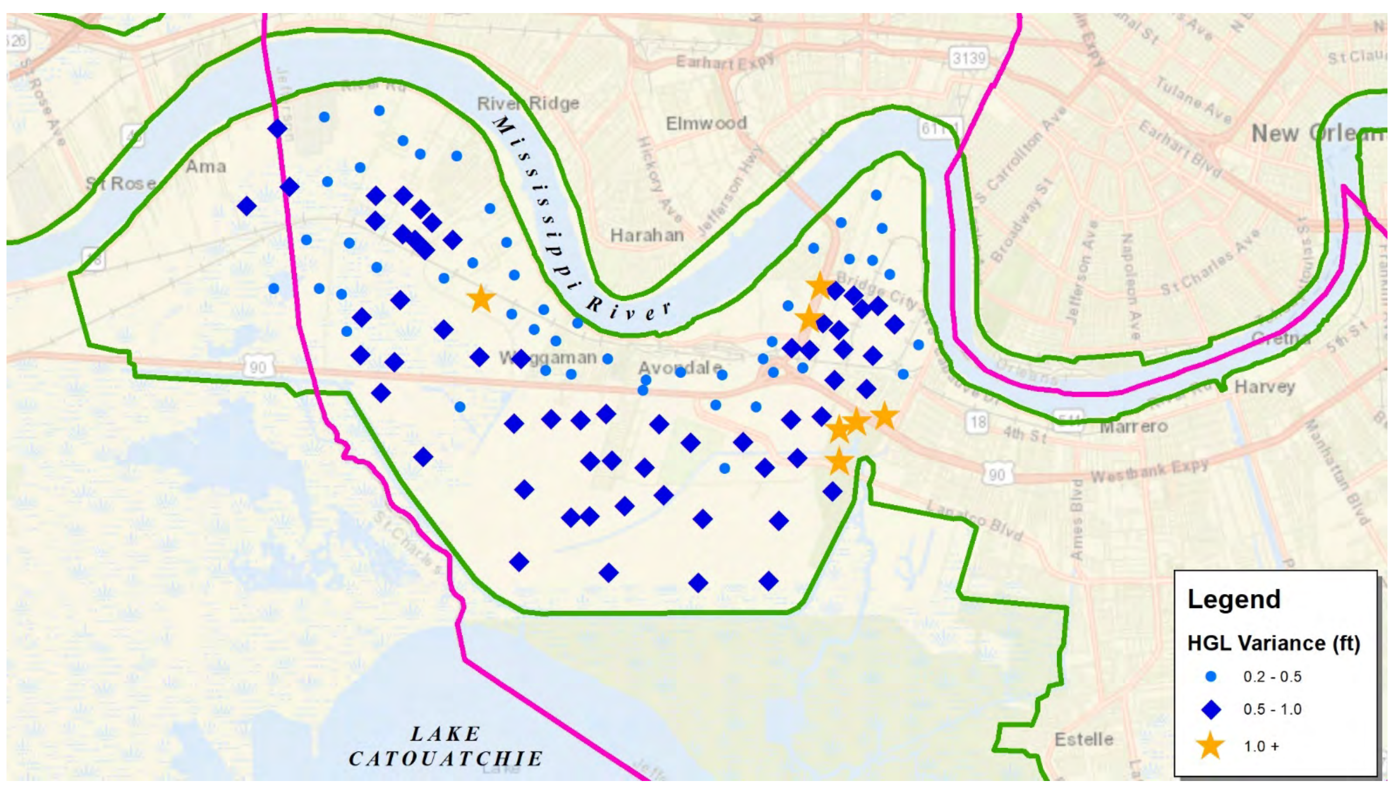

Figure A37: 100-Year, Noaa Storm, 5.9-ft Sea Level Rise, Future Development

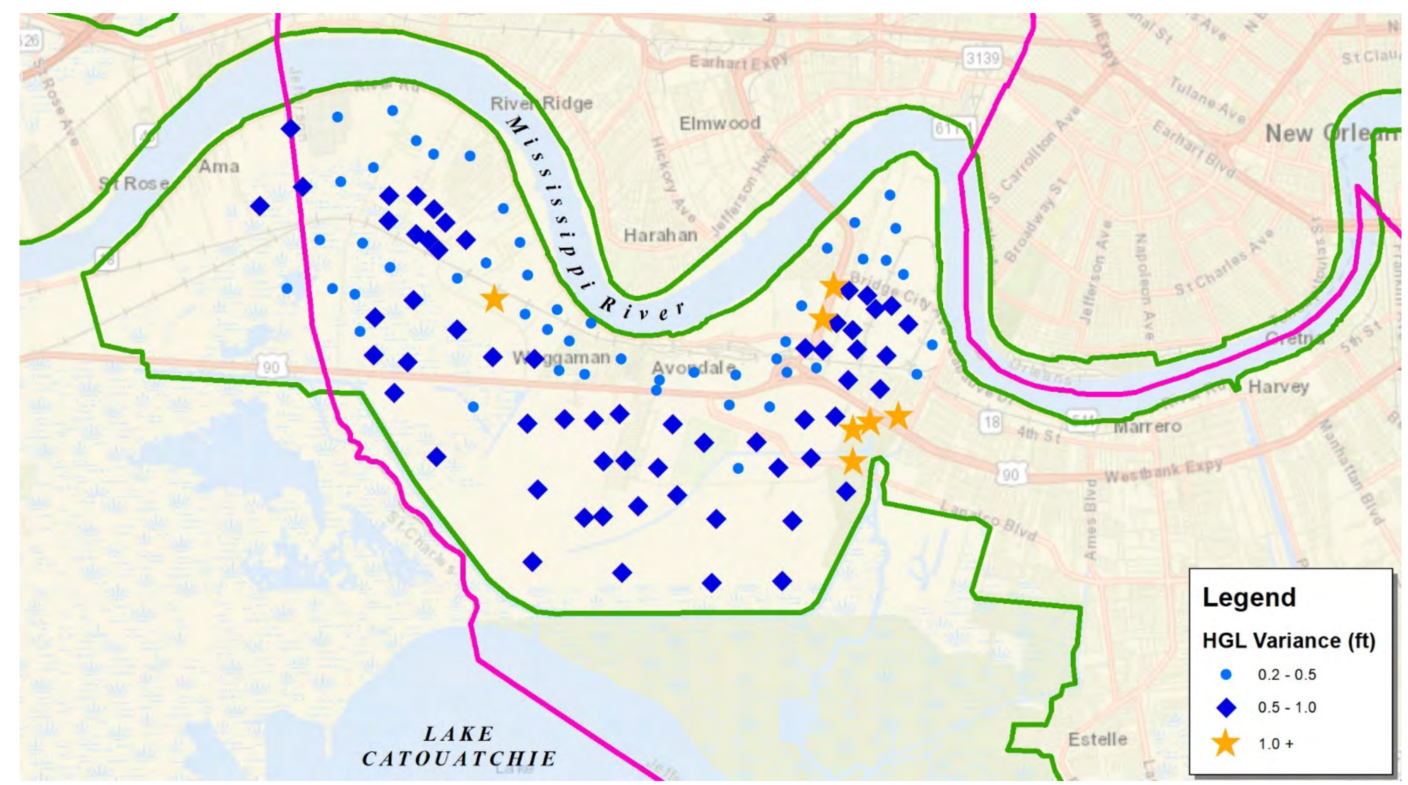

Figure A38: 100-Year, Noaa Storm, 8.07-ft Sea Level Rise, Future Development

Appendix B: Hydrograph Modeling Methods

APPENDIX B Hydrograph Modeling Methods

The "CRS Credit for Stormwater Management" publication states that communities are required to model future land use using a hydrograph approach to account for both the increased volume of and the increased duration of runoff. This appendix addresses the modeling approach and adjustments made for changing storm pattern, sea level, and land use.

B1. SWMM Models Used in Analysis

The hydrograph modeling approach used in this study was based on EPA SWMM models which were developed from HEC HMS models and HEC RAS models used in previous Flood Insurance Studies (FIS).

Delineation of the Eastbank storage areas as shown in the FIS are depicted in Figure B1. The equivalent storage area delineations from the 2012 HEC-RAS model are shown in Figure B2. The storage areas from the Parish SWMM model, which are the storage areas used in this analysis, are depicted in Figure B3. The Eastbank canal system used in the HEC-RAS model is shown in Figure B4. The Eastbank canal system used in the Parish SWMM model, which is expanded to include major pipe systems, is shown in Figure B5.

Delineation of the Catouatche Polder storage areas as shown in the FIS are depicted in Figure B6. The equivalent storage area delineations from the Parish SWMM model, which was used in this analysis, are shown in Figure B7.

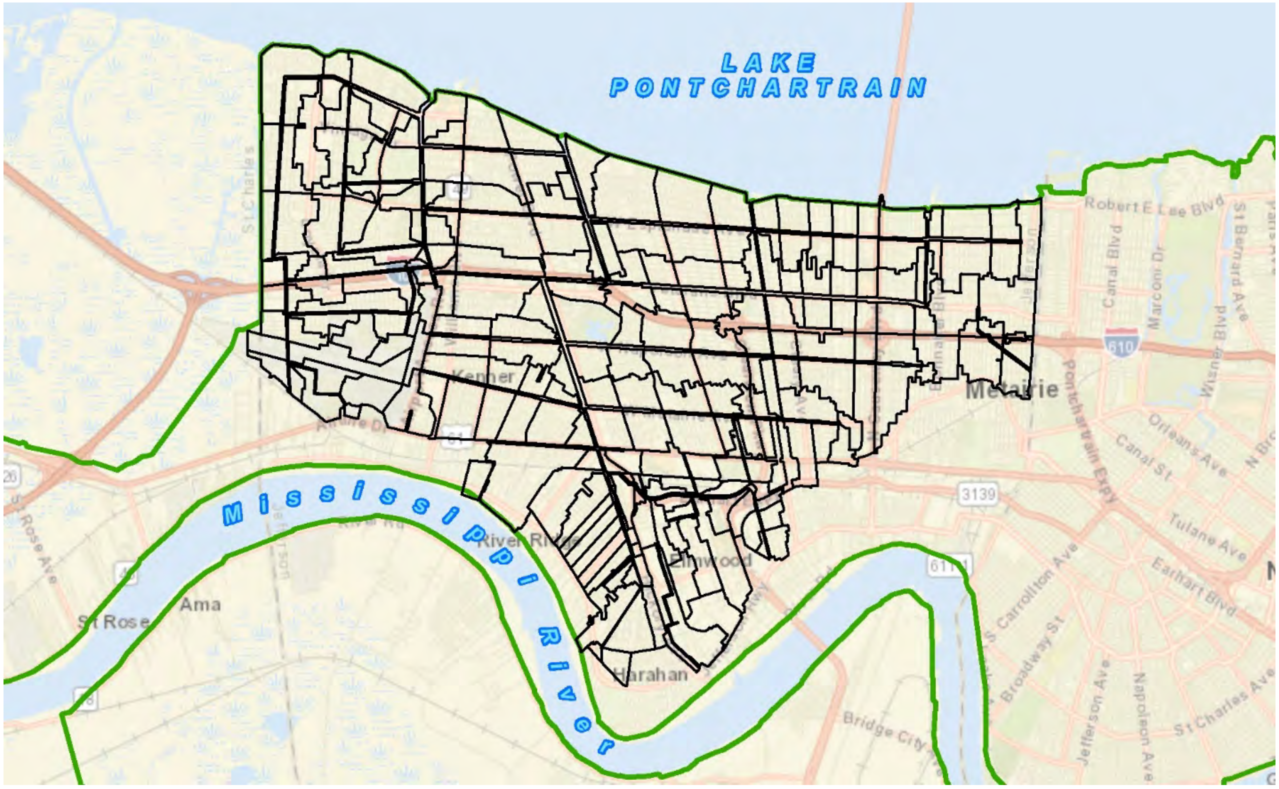

Figure B1: Jefferson Parish Eastbank Polder Storage Areas As-Per FIS

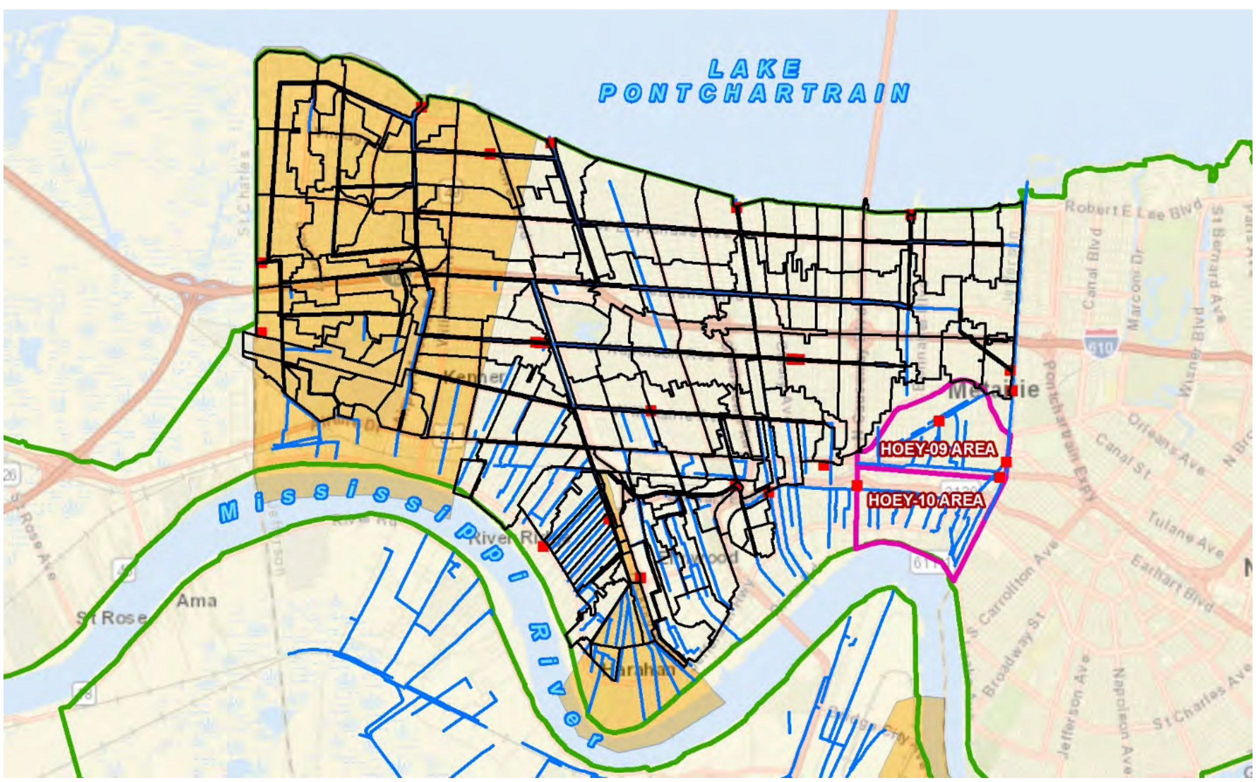

Figure B2: Eastbank Polder Storage Areas As-Per HEC-RAS Model

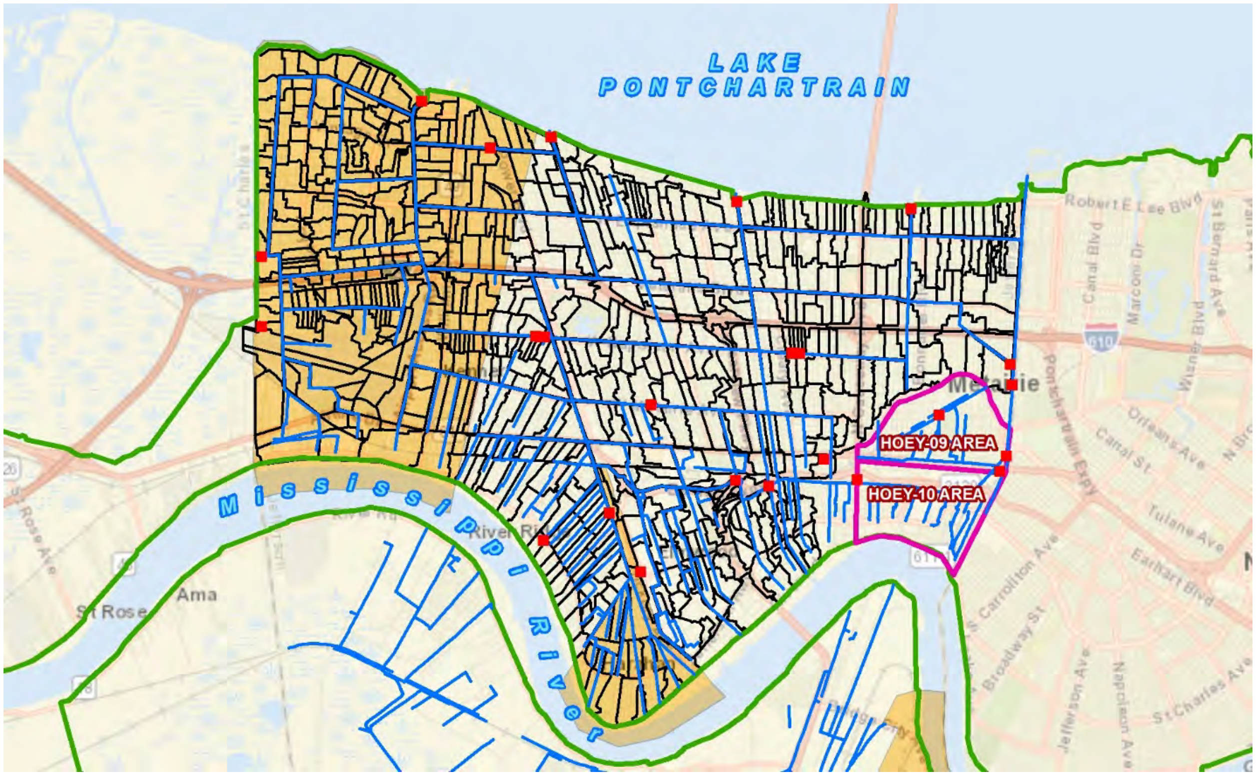

Figure B3: Eastbank Polder Storage Areas As-Per Parish SWMM Model

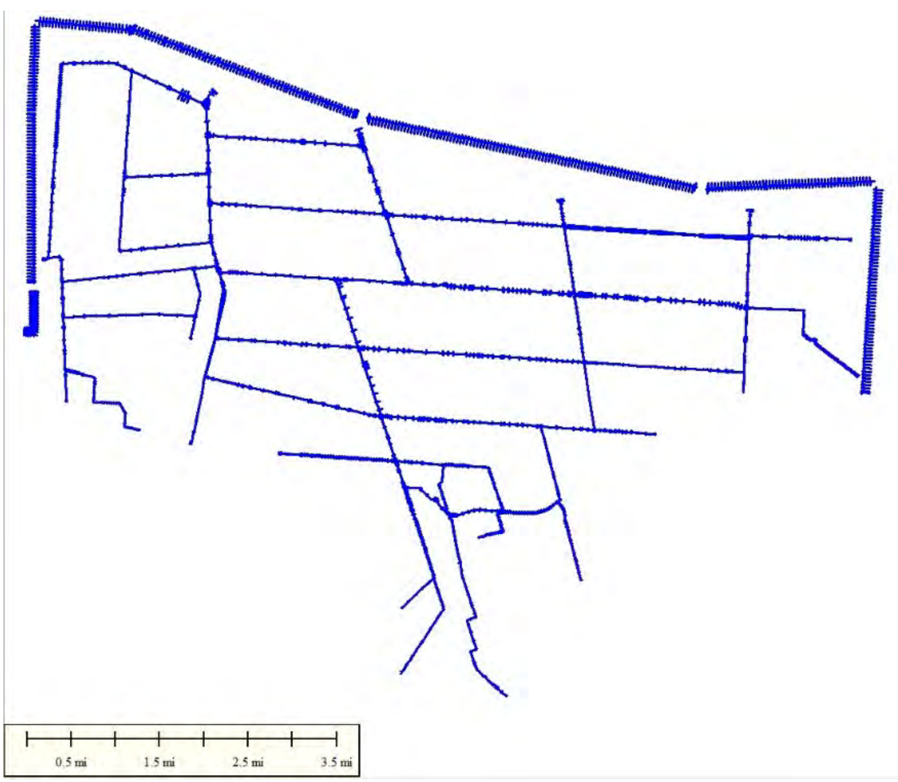

Figure B4: Eastbank Canal System As-Per HEC-RAS Model

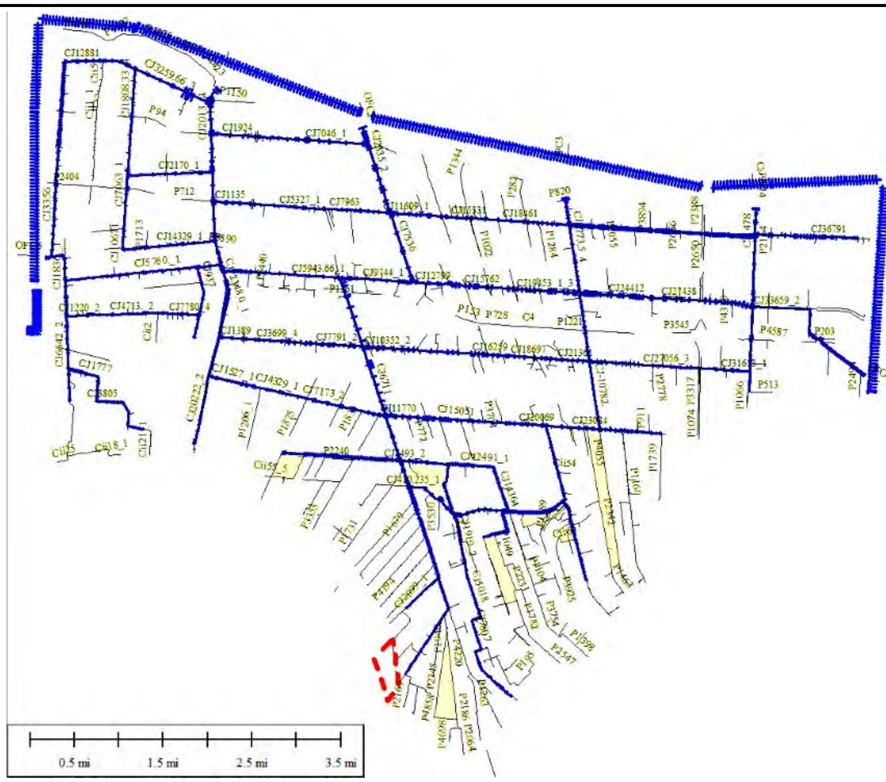

Figure B5: Eastbank FIGCanal and Drainage System As-Per SWMM Model

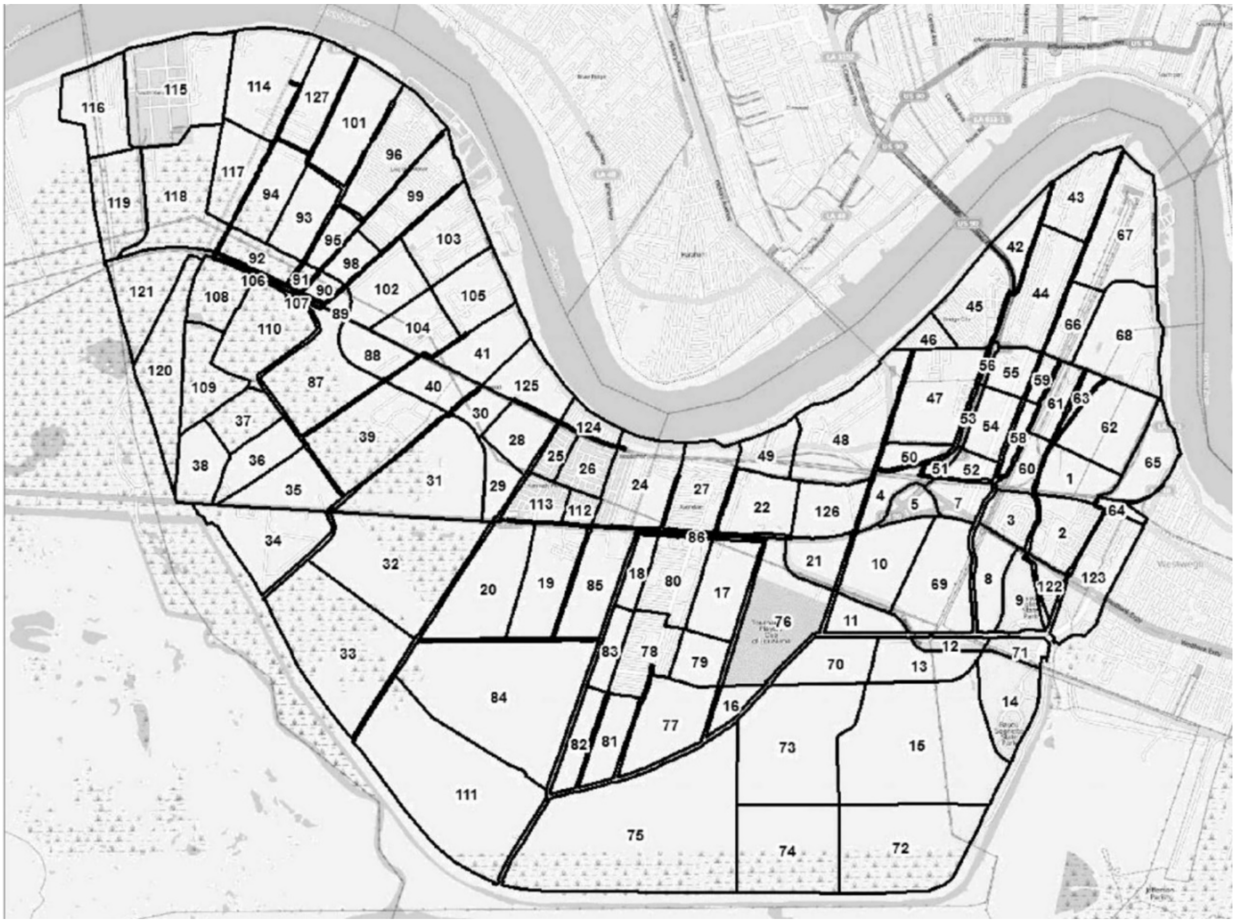

Figure B6: Catouatche Polder Storage Areas As-Per FIS

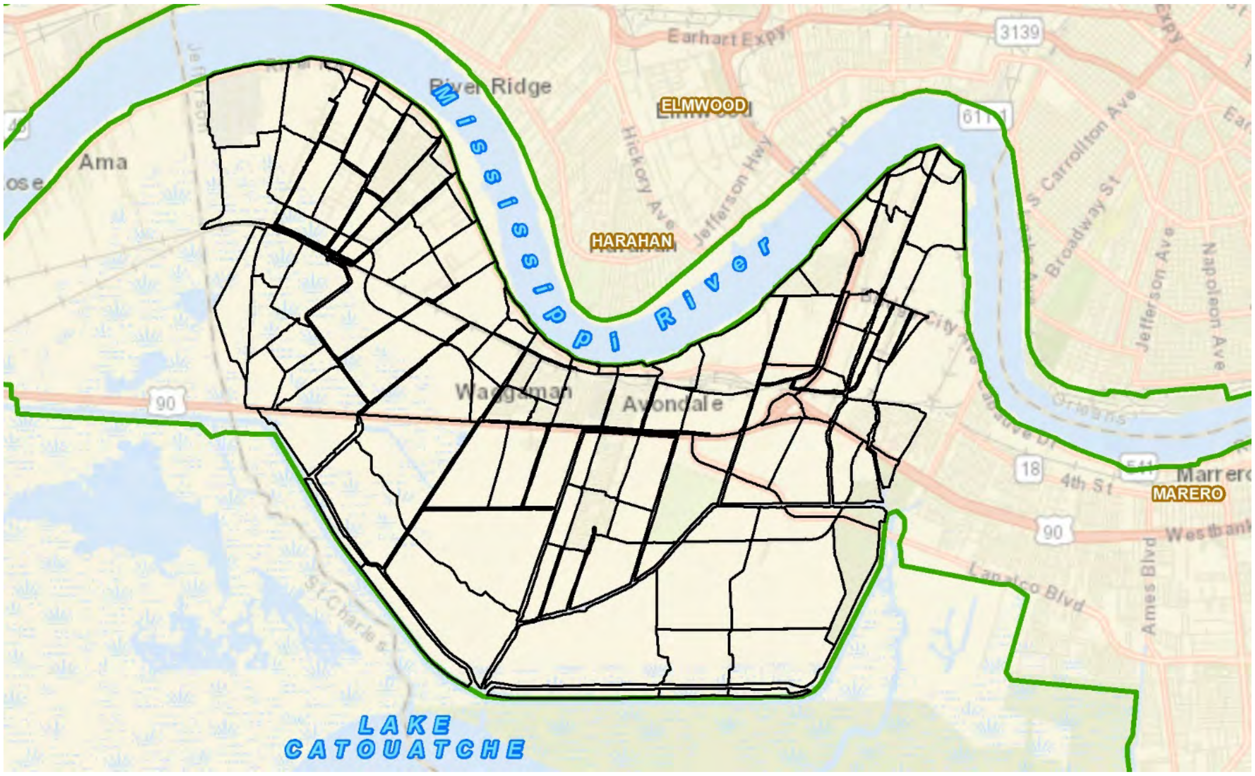

Figure B7: Catouatche Polder Storage Areas As-Per Parish SWMM Model

In order to isolate the impacts of sea level, modified rainfall, and development, EPA SWMM models were developed for each of the individual conditions and each of the combined conditions. The resultant list of models are categorized as follows.

Existing Conditions Models in Jefferson Eastbank Basin

Technical Paper 40 Storm with Current Sea -Level

- Jeb_Swm_Tp40_RasTw_010_210201a1.inp
- Jeb_Swm_Tp40_RasTw_025_210201a1.inp
- Jeb_Swm_Tp40_RasTw_100_210201a1.inp

Future Conditions Models in Jefferson Eastbank Basin

Technical Paper 40 Storm with Projected Future Sea -Levels

- Jeb_Swm_Tp40_RasTw+4_010_210201a1.inp
- Jeb_Swm_Tp40_RasTw+4_025_210201a1.inp
- Jeb_Swm_Tp40_RasTw+4_100_210201a1.inp
- Jeb_Swm_Tp40_RasTw+5p87_010_210201a1.inp
- Jeb_Swm_Tp40_RasTw+5p87_025_210201a1.inp
- Jeb_Swm_Tp40_RasTw+5p87_100_210201a1.inp
- Jeb_Swm_Tp40_RasTw+8p07_010_210803a1.inp
- Jeb_Swm_Tp40_RasTw+8p07_025_210803a1.inp
- Jeb_Swm_Tp40_RasTw+8p07_100_210803a1.inp

Jefferson Eastbank Basin NOAA Storm with Current Sea -Level

- Jeb_Swm_Noaa_RasTw_010_210201a1.inp
- Jeb_Swm_Noaa_RasTw_025_210201a1.inp
- Jeb_Swm_Noaa_RasTw_100_210201a1.inp

Jefferson Eastbank NOAA Storm with Projected Future Sea -Levels

- Jeb_Swm_Noaa_RasTw+4_010_210201a1.inp
- Jeb_Swm_Noaa_RasTw+4_025_210201a1.inp
- Jeb_Swm_Noaa_RasTw+4_100_210201a1.inp
- Jeb_Swm_Noaa_RasTw+5p87_010_210201a1.inp
- Jeb_Swm_Noaa_RasTw+5p87_025_210201a1.inp
- Jeb_Swm_Noaa_RasTw+5p87_100_210201a1.inp
- Jeb_Swm_Noaa_RasTw+8p07_100_210803a1.inp

Current Land Use Conditions Models in Catouatche Basin

Technical Paper 40 Storm with Current Sea -Level

- Cat_Swm_Tp40_FisTw_010_210201a1.inp
- Cat_Swm_Tp40_FisTw_025_210201a1.inp
- Cat_Swm_Tp40_FisTw_100_210201a1.inp

Current Land Use Conditions Models in Catouatche Basin

Technical Paper 40 Storm with Projected Future Sea -Levels

- Cat_Swm_Tp40_FisTw+4_010_210201a1.inp
- Cat_Swm_Tp40_FisTw+4_025_210201a1.inp
- Cat_Swm_Tp40_FisTw+4_100_210201a1.inp
- Cat_Swm_Tp40_FisTw+5p87_010_210201a1.inp
- Cat_Swm_Tp40_FisTw+5p87_025_210201a1.inp
- Cat_Swm_Tp40_FisTw+5p87_100_210201a1.inp
- Cat_Swm_Tp40_FisTw+8p07_010_210803a1.inp
- Cat_Swm_Tp40_FisTw+8p07_025_210803a1.inp
- Cat_Swm_Tp40_FisTw+8p07_100_210803a1.inp

Current Land Use Conditions Models in Catouatche Basin

NOAA Atlas 14 Storm with Current Sea -Level

- Cat_Swm_Noaa_Tp40_FisTw_010_210201a1.inp
- Cat_Swm_Noaa_Tp40_FisTw_025_210201a1.inp
- Cat_Swm_Noaa_Tp40_FisTw_100_210201a1.inp

Current Land Use Conditions Models in Catouatche Basin

Noaa Atlas 14 Storm with Projected Future Sea -Levels

- Cat_Swm_Noaa_Tp40_FisTw+4_010_210201a1.inp
- Cat_Swm_Noaa_Tp40_FisTw+4_025_210201a1.inp
- Cat_Swm_Noaa_Tp40_FisTw+4_100_210201a1.inp
- Cat_Swm_Noaa_Tp40_FisTw+5p87_010_210201a1.inp
- Cat_Swm_Noaa_Tp40_FisTw+5p87_025_210201a1.inp
- Cat_Swm_Noaa_Tp40_FisTw+5p87_100_210201a1.inp
- Cat_Swm_Noaa_Tp40_FisTw+8p07_100_210201a1.inp

Future Land Use Adjustment Condition Models in Catouatchie Basin

Technical Paper 40 Storm with Current Sea -Level

- CatFuture_Swm_Tp40_FisTw_010_210201a1.inp
- CatFuture_Swm_Tp40_FisTw_025_210201a1.inp
- CatFuture_Swm_Tp40_FisTw_100_210201a1.inp

Future Land Use Adjustment Condition Models in Catouatchie Basin

NOAA Storm with Current Sea -Level

- CatFuture_Swm_Noaa_FisTw_010_210201a1.inp
- CatFuture_Swm_Noaa_FisTw_025_210201a1.inp
- CatFuture_Swm_Noaa_FisTw_100_210201a1.inp

Future Land Use Adjustment Condition Models in Catouatchie Basin

Technical Paper 40 Storm and NOAA Atlas 14 with Projected Sea -Levels

- CatFuture_Swm_Tp40_FisTw+4_010_210201a1.inp
- CatFuture_Swm_Tp40_FisTw+4_025_210201a1.inp
- CatFuture_Swm_Noaa_FisTw+4_100_210201a1.inp
- CatFuture_Swm_Tp40_FisTw+5p87_010_210201a1.inp
- CatFuture_Swm_Tp40_FisTw+5p87_025_210201a1.inp
- CatFuture_Swm_Noaa_FisTw+5p87_100_210201a1.inp
- CatFuture_Swm_Tp40_FisTw+8p07_100_210803a1.inp
- CatFuture_Swm_Tp40_FisTw+8p07_100_210803a1.inp
- CatFuture_Swm_Noaa_FisTw+8p07_100_210803a1.inp

B.2 Rainfall

The February 2, 2018, flood insurance study states that the Parish-wide analysis performed in 1995 was based on rainfall frequency and duration data derived from the "Rainfall Frequency Atlas of the United States (U.S. Department of Commerce, 1963) which is referenced in this analysis as Technical Paper 40 (TP-40). It further states that in the Parish-wide revision of February 2018, rainfall was estimated using information obtained from the National Weather Service's (NWS) Technical Memorandum HYDRO-35 (NOAA, 1977), and the Southeastern Region Climatic Center (SRCC) Technical Report 97-1 (University of Pittsburg at Johnstown, PA, 1997).

Rainfall considered to be near equivalent to the TP-40 rainfall, or historic rain used in previous analyses when compared to the more recent NOAA Atlas 14 rainfall, was taken from several sources. The 10-year storm of 9.40 inches was taken from the value used in the current Parish EPA SWMM model. The 25-year storm of 11.12 inches was taken from the table depicted below in Figure B8. The 100-year storm of 13.00 inches was taken from the HEC-HMS model and described as the FEMA 100-yr, 24-hr storm for East Bank, updated for SELA analysis, last modified August 2013. These values were compared to the NRCS storm data based on TP-40 rainfall data for Jefferson Parish which are shown in Figure B9, and were found to be within 0.5-inches for each of the frequency conditions and so are categorized as TP-40 storms for purposes of this comparative analysis.

NOAA Atlas 14 precipitation-duration-frequency values used in this study were taken from the NOAA Atlas 14, Volume 9, Version 2, Metairie Station ID:16-6157 values published by NOAA which are tabulated in Figure B10.

The 10-Year, 25-Year, and 100-Year frequency values used in the analysis for the TP-40 and NOAA Atlas 14 rainfall conditions are summarized in Figure B11.

PRECIPITATION IN INCHES

FOR STORMS OF RETURN FREQUENCIES BETWEEN 2 AND 100 YRS. FOR PERIODS BETWEEN 5 MIN. AND 24 HRS. TO BE USED ALONG THE TEXAS, LOUISIANA, MISS, ALA & N.W. FLA. COASTS WITHIN 100 MILES OF THE GULF BUT EXCLUDING LOWER PLAQ. & ST. BERNARD PARISHES.

RETURN PERIOD (YRS)	DURATION OF STORM (SOURCE T.P. 40)									
	5 MIN.	10 MIN.	15 MIN.	30 MIN.	1 HR.	2 HR.	3 HR.	6 HR.	12 HR.	24 HR.
2	0.6"	0.98"	1.25"	1.85"	2.50"	2.89"	3.27"	4.25"	5.13"	6.0"
5	0.66	1.10	1.41	2.18	3.01"	3.55	[illegible]	[illegible]	[illegible]	[illegible]
10	0.70	1.20	1.54	2.42	3.37"	4.02	4.67	6.32	7.79	9.26
25	0.78	1.35	1.74	2.79	3.97"	4.70	5.50	7.52	9.32	11.12
50	0.84	1.46	1.89	3.07	4.33"	[illegible]	6.14	8.45	10.51	[illegible]
100	0.90	1.58	2.05	3.35	4.75"	5.77	6.79	9.38	11.69	14.0

Figure B8: Jefferson Parish Precipitation-Duration-Frequency Values from TP-40

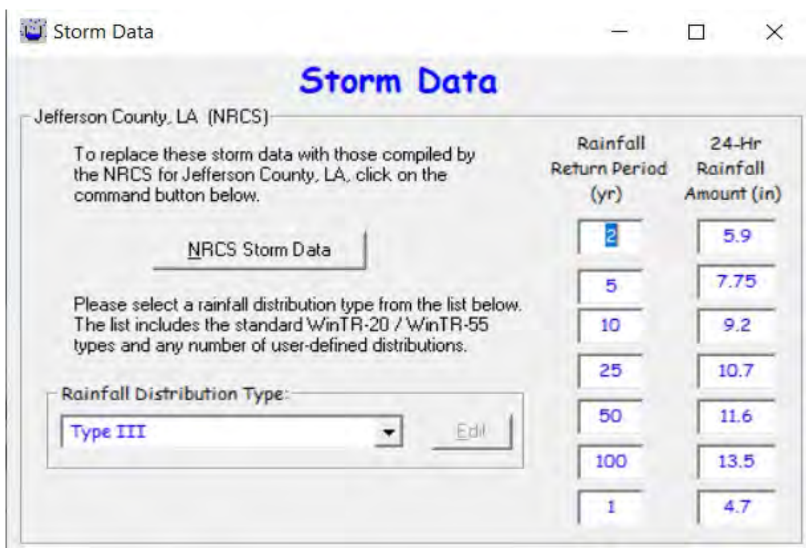

Figure B9: NRCS Precipitation-Duration-Frequency Values for Jefferson Parish (TP-40)

NOAA Atlas 14, Volume 9, Version 2 METAIRIE
Station ID: 16-6157
Location name: Metairie, Louisiana, USA*
Latitude: 29.9903°, Longitude: -90.1431°
Elevation:
Elevation (station metadata): 0 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.550 (0.442-0.685)	0.625 (0.501-0.779)	0.754 (0.602-0.942)	0.867 (0.688-1.09)	1.03 (0.790-1.34)	1.16 (0.868-1.53)	1.30 (0.934-1.75)	1.44 (0.992-2.00)	1.64 (1.08-2.34)	1.80 (1.15-2.60)
10-min	0.806 (0.647-1.00)	0.916 (0.734-1.14)	1.10 (0.882-1.38)	1.27 (1.01-1.59)	1.51 (1.16-1.96)	1.70 (1.27-2.24)	1.90 (1.37-2.56)	2.11 (1.45-2.93)	2.41 (1.59-3.42)	2.64 (1.69-3.80)
30-min	1.49 (1.20-1.86)	1.71 (1.37-2.13)	2.08 (1.66-2.60)	2.41 (1.91-3.02)	2.87 (2.20-3.74)	3.25 (2.43-4.28)	3.64 (2.62-4.91)	4.05 (2.78-5.61)	4.62 (3.04-6.57)	5.06 (3.23-7.29)
60-min	2.03 (1.63-2.53)	2.32 (1.86-2.89)	2.85 (2.27-3.56)	3.34 (2.65-4.19)	4.09 (3.16-5.38)	4.73 (3.55-6.28)	5.42 (3.92-7.37)	6.18 (4.26-8.62)	7.26 (4.79-10.4)	8.14 (5.20-11.7)
12-hr	4.05 (3.36-4.88)	4.69 (3.88-5.65)	5.92 (4.88-7.16)	7.13 (5.84-8.66)	9.06 (7.29-11.7)	10.8 (8.39-14.0)	12.7 (9.49-16.8)	14.8 (10.6-20.1)	17.9 (12.2-24.9)	20.4 (13.5-28.6)
24-hr	4.65 (3.89-5.55)	5.45 (4.55-6.51)	6.93 (5.77-8.30)	8.32 (6.88-10.0)	10.5 (8.48-13.3)	12.3 (9.68-15.8)	14.4 (10.8-18.8)	16.6 (12.0-22.3)	19.8 (13.7-27.3)	22.4 (15.0-31.1)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.
Please refer to NOAA Atlas 14 document for more information.

Figure B10: NOAA Atlas-14 Precipitation-Duration-Frequency Values for Metairie

	Duration	Point precipitation (inches)		
Probability:		10%	4%	1%
Return Period:		**10-YR**	**25-YR**	**100-YR**
Metairie NOAA Atlas 14:	24-hr	8.33	10.50	14.40
Jefferson Parish TP 40 Metairie:	24-hr	9.40	11.12	13.00

Figure B11: Precipitation-Duration-Frequency Values for SWMM Models

B.3 Sea Level Adjustments

Sea Level Adjustments were made by adding projected future sea levels to the tailwater elevations at the outfalls as presented in the 2012 RAS models. The tailwater elevations were based on Adcirc modeling of Lake Ponchartrain for the Eastbank Polder. The sea levels were added to the Parish SWMMM model tailwater elevations for the Catouatche Polder. Sea Level values were taken from the USACE Sea Level Change Curve Calculator (2021.01) using parameters for Grand Isle as shown in Figure B12 and using the Intermediate values and the Int-High values for the Year 2100 shown in Figure B13. The Intermediate values were used to derive the Year 2075 sea level rise of 4.0-ft and the Year 2100 sea level rise of 5.9-ft. The Int-High values were used to derive the Year 2100 of 8.07-ft prescribed in the "CRS Credit for Stormwater Management" publications, page 16, prerequisite (1), b.

USACE Sea Level Change Curve Calculator (2021.12)

Project Name: Jefferson Parish WMP Comparison
Select Gauge: GRAND ISLE PSMSL
Scenarios Source: NOAA et al. 2017

Output Units: (•) Feet ( ) Meters
Output Datum: (•) LMSL ( ) NAVD88
Critical Elevation #1 (ft) : 0 NAVD88 - Description:
Critical Elevation #2 (ft) : 0 NAVD88 - Description:

NOAA et al. 2017 options
Show Grid Points ☐
Show USACE 2013 Curves ☐
Show 2100 to 2200 ☐
Adjust to MSL(83-01) Datum: ? ☐
Lines Type: (•) None ( ) Interpolated ( ) Polynomial Trend
Point Shape: (•) Circle ( ) Square ( ) Triangle
Vertical Land Movement (ft/yr) : 0.02320
Plot 66 Percentile Confidence Band: None

Figure B12: USACE Sea Level Parameters for Grand Isle

Jefferson Parish WMP Comparison
Scenarios for GRAND ISLE
NOAA2017 VLM: 0.02320 feet/yr
All values are expressed in feet

Year	NOAA2017 VLM	NOAA2017 Low	NOAA2017 Int-Low	NOAA2017 Intermediate	NOAA2017 Int-High	NOAA2017 High	NOAA2017 Extreme
2000	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2010	0.23	0.33	0.36	0.43	0.52	0.59	0.59
2020	0.46	0.69	0.75	0.89	1.02	1.12	1.18
2030	0.70	1.05	1.15	1.38	1.57	1.80	1.94
2040	0.93	1.41	1.54	1.87	2.20	2.56	2.79
2050	1.16	1.77	1.94	2.43	2.92	3.51	3.90
2060	1.39	2.13	2.33	3.05	3.77	4.63	5.25
2070	1.62	2.46	2.72	3.67	4.69	5.87	6.73
2080	1.86	2.82	3.15	4.40	5.71	7.25	8.37
2090	2.09	3.12	3.54	5.12	6.82	8.73	10.30
2100	2.32	3.44	3.87	5.87	8.07	10.40	12.40

Revised 11 February 2021

Figure B13: USACE Sea Level Adjustment Values for Grand Isle

B.4 Land Use Adjustments

Considering adjustments for future land use, the Eastbank Polder was considered to be fully developed so that no adjustments were made for future land use. The Catouatche Polder was revised to reflect development as being completely built out according to the Parish future land development plan as shown in Figure B14. The revision to reflect development was made to the impervious factor parameter in the SWMM model. Impervious values for the different development conditions were generally taken from the Jefferson Parish DPW Runoff Factor Table as shown in Figure B15. The DPW categories were combined and re-categorized to match the future land use conditions as shown in Figure B16 and input in the SWMM model accordingly.

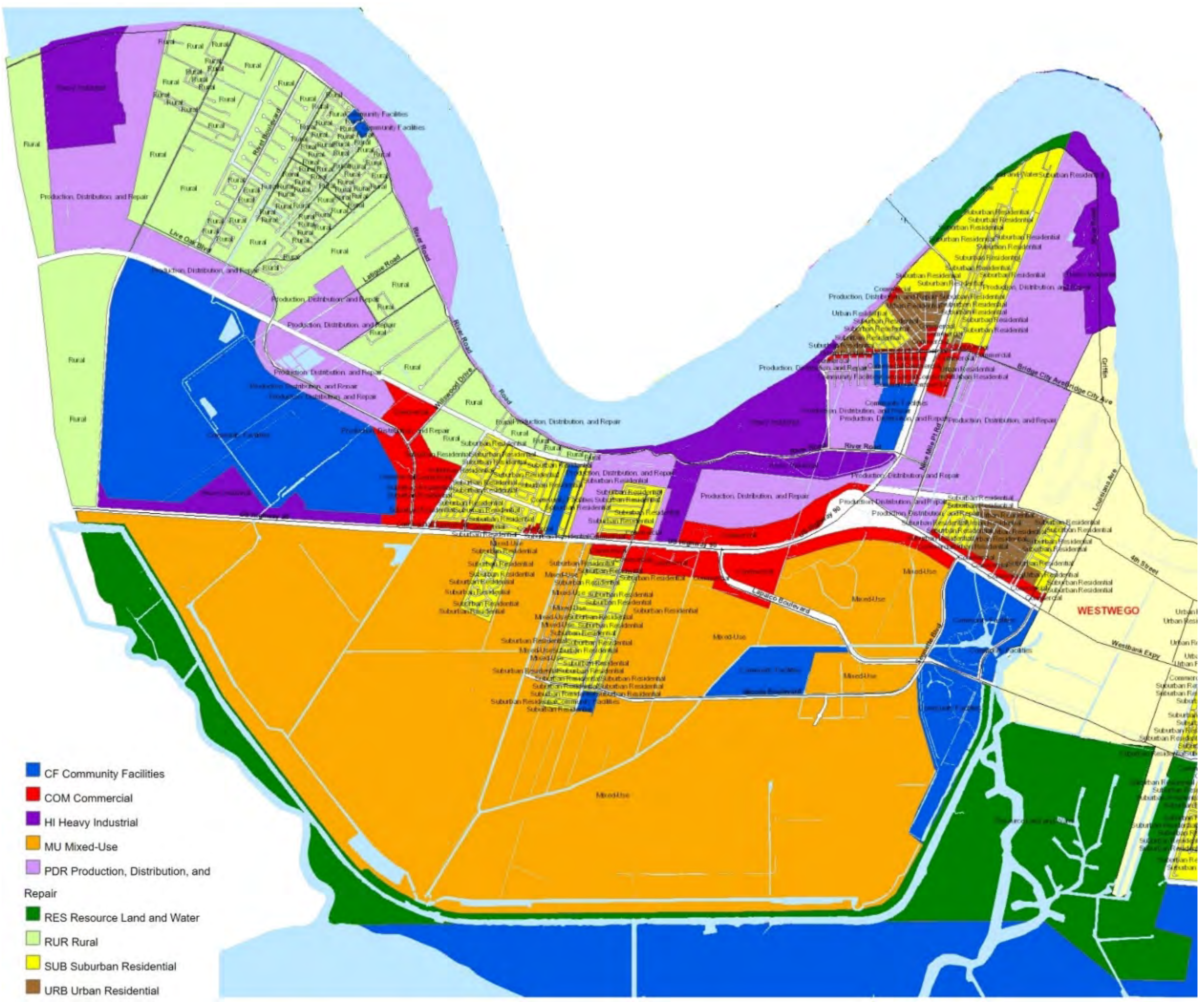

Figure B14: Catouatche Polder Future Land Use Plan

TABLE 2-1
RATIONAL METHOD RUNOFF COEFFICIENTS
BY LAND USE TYPES
FOR USE IN Q = CiA

Land Use Type	Runoff Coefficients (C)
Single-Family Dwelling District, 1 acre	0.38
Single-Family Dwelling District, 1/2 acre	0.4
Single-Family Dwelling District, (16,000 sq. ft.--5,000.sq. ft.)	0.45
Duplex Dwelling District	0.6
Townhouse Dwelling District	0.8
Multiple-Family Dwelling District	0.8
Mobile Home District	0.55
Agricultural District	Variable
Parking District	0.9
Office District	0.9
Neighborhood Service District	0.9
Shopping Center District	0.9
General Retail District	0.9
Light Commercial District	0.9
Central Area District	0.9
Heavy Commercial District	0.9
Industrial District	0.7 to 0.90
Churches	0.7 to 0.90
Schools	0.5 to 0.90
Park & Greenbelt;	0.3 to 0.70
Slope less than 2%	0.4
Slope 2% - 7%	0.45
Slope1/4? 7%	0.5
Cemetery	0.3 to 0.5

Figure B15: Jefferson Parish DPW Runoff Factor Table

The first seven FLU categories generally correspond to levels of intensity or density, ranging from			
the lowest density rural and residential areas to commercial and the heaviest intensity industrial uses.			
The last two FLU categories – CF and RES – do not refer to intensity, but rather recognize the areas of			
the parish that serve vital functions as community facilities or resource lands and water.			
		Impervious %	
	Rural (RUR)	Park & Greenbelt;	0.3 to 0.70
	Suburban Residential (SUB)	Single-Family Dwelling District, 1/2 acre	0.4
	Urban Residential (URB)	Multiple-Family Dwelling District	0.8
	Commercial (COM)	Light Commercial District	0.9
	Mixed-Use (MU)	Neighborhood Service District	0.9
	Production, Distribution, and Repair (PDR)	Heavy Commercial District	0.9
	Heavy Industrial (HI)	Industrial District	0.7 to 0.90
	Community Facilities (CF)	Neighborhood Service District	0.9
	Resource Land and Water (RES)		

Figure B16: Model Adjustment Factors for Future Land Use in Catouatche Basin